Hatfield

RF COMPONENTS

Cooke International Services

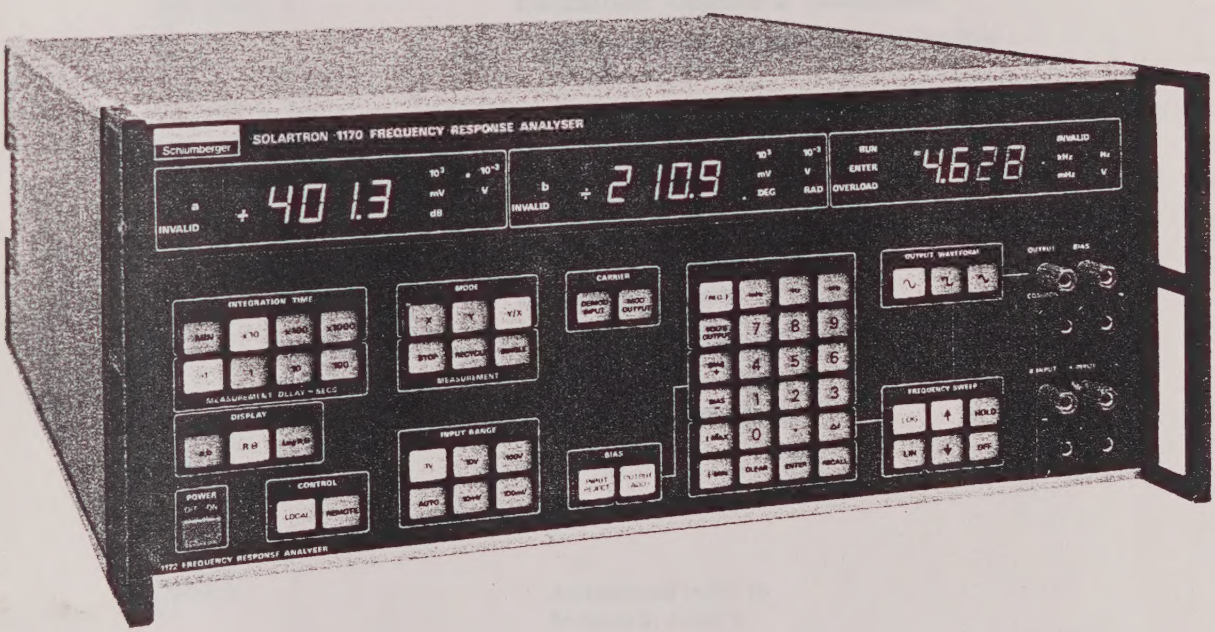
SOLARTRON 1172

MANUAL

UNIT 4, FORDINGBRIDGE SITE, MAIN ROAD, BARNHAM, BOGNOR REGIS, WEST SUSSEX PO22 0EB
Telephone 0243 54 5111/2 Fax 0243 54 2457

MP MASTER
MA24159

FREQUENCY RESPONSE ANALYSER 1172



Part No. A1720164

Date of Issue: Feb. 1980

Schlumberger

THE SOLARTRON ELECTRONIC GROUP LIMITED
FARNBOROUGH HAMPSHIRE ENGLAND GU14 7PW
TEL: FARNBOROUGH 44433 (STD 0252)
CABLES: SOLARTRON FARNBOROUGH HANTS
TELEX: 858245 SOLARTRON FARNBOROUGH

OPERATING MANUAL

19©80

CONTENTS

Instructions on the use of the peripheral units that plug into the rear of the 1172 are given in a separate manual.

SECTION 1	**Principles of Operation**	A brief technical description
SECTION 2	**The Display, Front Panel & Rear Panel**	A detailed description of the purpose and function of all facilities.
SECTION 3	**Installation, Options & Accessories**	How to connect the power : extra facilities : standard accessories.
SECTION 4	**Using the Controls**	How to program the instrument - with examples.
SECTION 5	**Functional Checks**	How to check the overall performance.
SECTION 6	**Technical Specification**	
INDEX	Alphabetical index to Sections 2, 4 and 5.	
PC1 to PC10	**Performance Checks**	

SECTION 1 Principles of Operation

BASIC PRINCIPLES OF OPERATION

The instrument affords a rapid and accurate means of measuring a system's frequency response to various input signals. It consists basically of a programmable generator that provides a stimulating signal, an analyser that determines the system response and a display that presents the result.

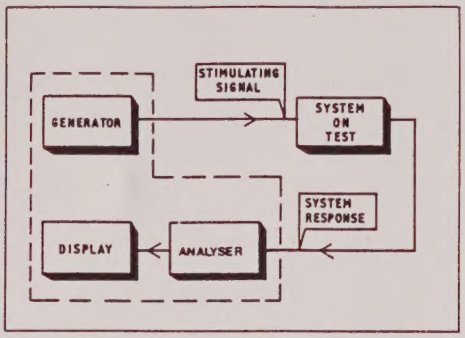


Fig. 1.1 Basic measurement technique.

The Generator

The generator provides an output signal of known amplitude and frequency which is in the form $A \sin \omega t$. This signal is applied to the system to be tested.

The System's Response

The fundamental response of the system to its input signal will be in the form $R \sin(\omega t + \theta)$. In simple terms, this means that the system changes the amplitude of its input to a new value R and introduces a phase angle θ. As well as this fundamental term, harmonics due to system non-linearities together with random noise will also be present in the system's output.

The Analyser

The system's response is analysed by a correlation process to determine R and θ. This technique has the advantage of rejecting all harmonics present in the system's output and also of minimising the effects of random noise.

The Display

The amplitude of the system's fundamental response (R) and its phase angle (θ) relative to the original output signal from the generator are displayed once a measurement has been completed.

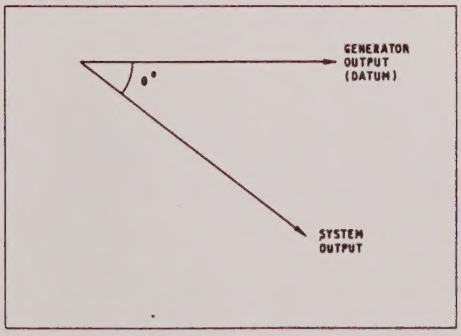


Fig. 1.2 Presentation of results.

SECTION 2 The Display & Controls

ANALYSER DISPLAYS

Polar Display (R, θ)

The system output is specified as an amplitude and phase angle relative to the generator output (datum).

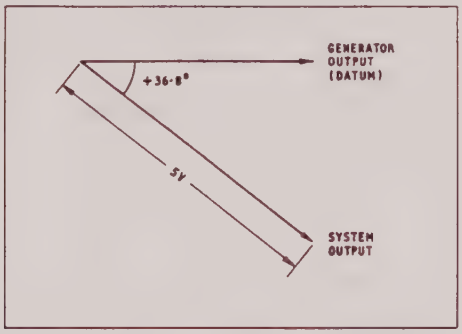


Fig. 2.1 Polar Display

Log. Polar Display (Log R, θ)

Instead of presenting the system output as a voltage, it can be displayed as a voltage gain in dB relative to some reference level. The 0dB reference used in this instrument is 10μV so that an amplitude of 5V is displayed as 114dB.

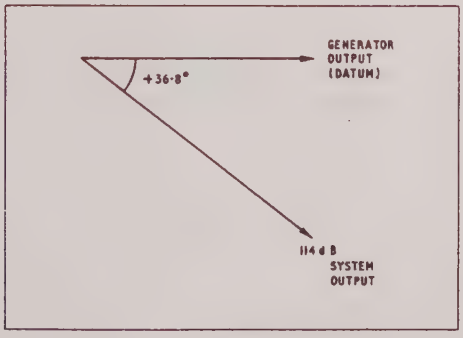


Fig. 2.2 Log Polar Display.

Note: For both Polar and Log. Polar Displays the phase angle is measured in a clockwise direction from the datum and is presented as a positive angle.

Cartesian Display

The system output can also be accurately defined by specifying its co-ordinates on two axes **a** and **b**.

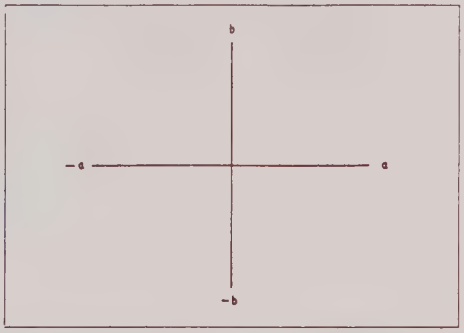


Fig. 2.3 If both axes are extended to include negative values, phase angles in any of the four quadrants can be specified.

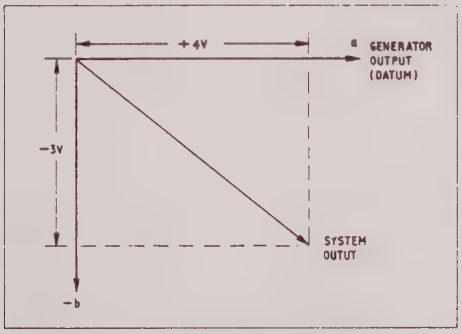


Fig. 2.4 The display gives the amplitude of the co-ordinates on the a and b axes. This specifies both the amplitude and phase angle of the system output.

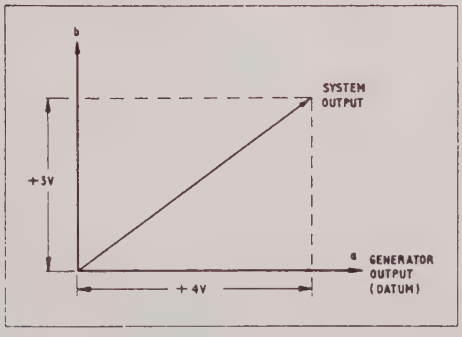


Fig. 2.5 A phase angle having a and b co-ordinates of +4V and +3V.

Point to Point Measurements

By selecting the Y/X mode, the ratio between two signals can be calculated and then displayed in Cartesian, Polar or Log. Polar form as required.

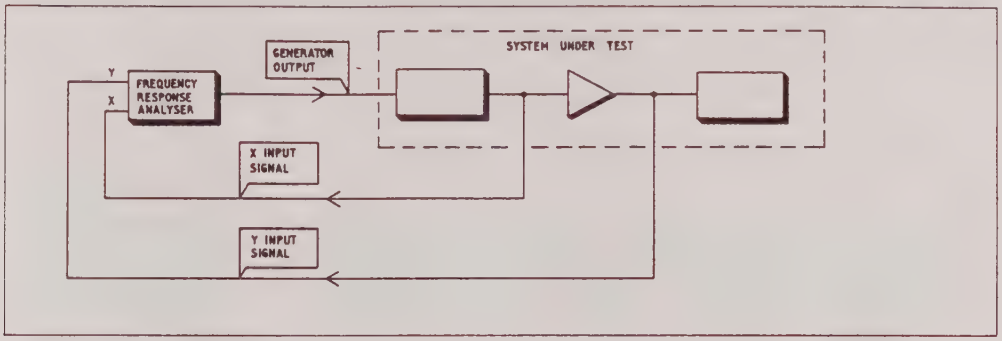


Fig. 2.6 Measurement of the ratio between an amplifier output (Y input signal) and its input (X input signal) allows a calculation of gain (Y/X) to be made.

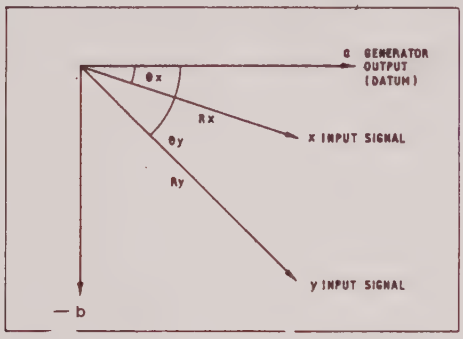


Fig. 2.7 As a first step in a point to point measurement the X and Y input signals are analysed separately and the amplitude R and phase angle θ of each signal is determined.

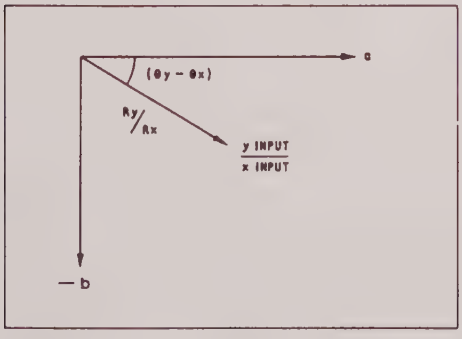


Fig. 2.8 The transfer function between the two voltage vectors X and Y is found by calculating the ratio $\frac{Ry}{Rx}$ and the angle $\theta y - \theta x$. This results in a single vector that can be represented in Cartesian, Polar or Log. Polar form.

The Front Panel

INTRODUCTION

The POWER push-button is the only mechanically operated switch. All other controls are electronic touch keys that have no moving parts and need only slight finger pressure to activate them. Most keys incorporate a lamp which lights to show that the data entered by that key has been accepted. For those keys that do not incorporate lamps, the selected data is registered on the display once it has been accepted.

Although the keys are themselves silent in operation, optional circuitry is included to give an audible click as each key is activated.

The function of each control on the front panel is described in detail. Examples in their use are given at the end of this section. (Refer also to "Using The Controls.")

The controls are grouped on the front panel according to their functions, and are described in the following order.

- Power
- Integration Time
- Measurement Delay
- Display
- Control
- Mode
- Measurement
- Input Range
- Bias
- Carrier
- Keyboard
- Frequency Sweep
- Output Waveform
- Output Terminals
- Input Terminals

POWER

A "press for on", "press for off" switch that connects mains power to the instrument.

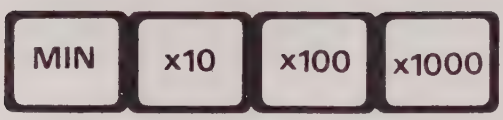
When POWER is switched on, certain front panel keys light up and the outputs are automatically set to zero volts at zero frequency. The in phase and quadrature displays are set to .0000mV and 000.0 DEG respectively and the keyboard display to .0000mHz.

NOTE: The internal states of some instruments are set correctly only when a measurement is taken. These states may affect the results of the first measurement. Therefore, after switch-on, it is recommended that a single measurement is performed under the following conditions:

Bias: INPUT REJECT
Volts Output: CLEAR, ENTER
Freq. f: CLEAR, 10.0Hz, ENTER
Mode: Y/X
Measurement: SINGLE

On completion of this measurement the instrument can be used as desired.

INTEGRATION TIME



In practical applications a certain amount of noise is invariably superimposed on the signal to be measured and may significantly affect measurement accuracy. Fortunately, one of the properties of random noise is that, considered over a long enough period, its average value tends towards zero. Since this is essentially an averaging instrument, when noise is troublesome, greater accuracy can be obtained by increasing the measurement time.

These four keys select the integration (averaging) time and can be activated at any time. Each key lights when activated but not more than one can be activated at a time. One of the four will always be lit.

Selection of MIN gives the shortest possible measurement time. At frequencies below 10Hz each measurement is completed in one cycle of the output waveform, e.g. at 1Hz, measurement time is 1s. Above 10Hz, measurement time varies between 0.1s and 0.2s depending on the frequency.

Integration Time can be changed while a measurement is in progress. If the time is increased, the actual time taken will be equal to the new time programmed. If the time is reduced, the actual integration will continue from the moment when the new value is programmed for a time not exceeding the new time. All results will be valid.

Selection of X10 gives a measurement time that is ten times longer than MIN. Below 10Hz each measurement will be completed in 10 cycles of the output waveform. Above 10Hz, measurement time is approximately 1s and depends on the frequency.

Selection of X100 gives a measurement time that is one hundred times longer than MIN. Below 10Hz, each measurement will be completed in 100 cycles of the output waveform. Above 10Hz, measurement time is approximately 10s and depends on the frequency.

Selection of X1000 gives a measurement time that is one thousand times longer than MIN. Below 10Hz, each measurement will be completed in 1000 cycles of the output waveform. Above 10Hz, measurement time is approximately 100s and depends on the frequency.

To prevent the selection of excessively long measurement periods, integration time is limited to a maximum of 10^5 seconds (approximately 24 hours). This means that at frequencies below 10mHz, the X100 and X1000 keys will not increase the integration time by the expected amount.

Further, due to practical limitations, at frequencies of 100Hz and above, the X100 and X1000 keys are both arranged to select the same integration time.

Actual integration periods are given in the following table:

FREQUENCY	MIN	X10	X100	X1000
100Hz and above	.1s *	1.0s *	10s *	10s *
Below 100Hz	.1s *	1.0s *	10s *	100s *
Below 10Hz	1 cycle	10 cycles	100 cycles	1000 cycles
Below 10mHz	1 cycle	10 cycles	100 cycles	100 cycles
Below 1mHz	1 cycle	10 cycles	10 cycles	10 cycles

Table 2.1 Integration Periods

* The minimum integration time is fixed at 0.1s. At generator frequencies above 10Hz, where one period of the output signal is less than this, integration continues until 0.1s has elapsed. However, since it must be carried out over a whole number of cycles of the generator output, integration has to be prolonged until the end of the next cycle. At these frequencies, therefore, integration time varies according to the period of the output signal.

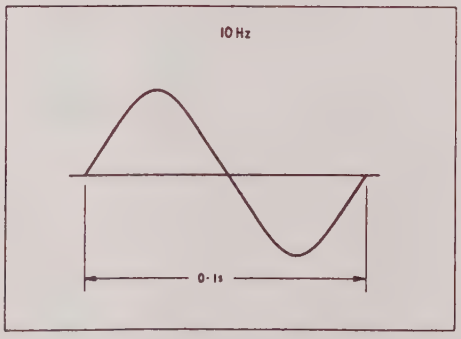


Fig. 2.9 The minimum integration period is 0.1s. At a frequency of 10Hz this represents one cycle of the output waveform and integration can therefore be completed satisfactorily in this time.

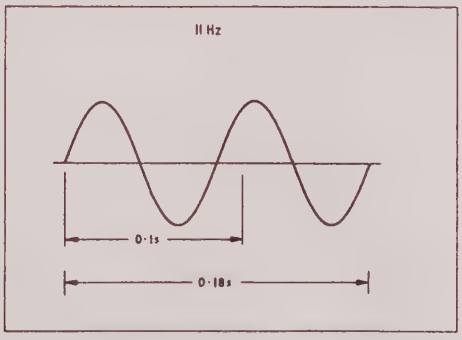


Fig. 2.10 At a frequency of 11Hz, more than one cycle of the output waveform is generated during the minimum 0.1s integration period. Integration continues until the completion of a whole number of cycles - after approximately 0.18s.

For clarity, the diagrams show integration starting at the 0^o point on the output waveform. In fact, the instrument can start integrating *anywhere in the cycle* without having to wait for the 0^o point to occur and is thus able to begin a measurement immediately it is commanded to do so.

This is of particular significance when making measurements at low frequencies where one cycle may last for several minutes.

MEASUREMENT DELAY

A typical system needs a finite time for its output to settle to a steady value after its input has been changed. The start of each measurement must be delayed until the transients caused by the change of input have died away and a valid result can be obtained.

This facility can also be used to provide a waiting period after each measurement, to allow an output device sufficient time to record the results.

These four keys select various delay periods. Each key lights when activated and only one can be activated at a time. One of the four will always be lit.

Measurement Delay can be changed while a measurement is in progress. If the time is increased, the actual time taken will be equal to the new time programmed. If the time is reduced, the actual delay will continue from the moment when the new value is programmed for a time not exceeding the new time. All results will be valid.

Selects a delay of 0.1s.

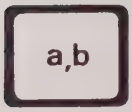
Selects a delay of 1s.

Selects a delay of 10s.

Selects a delay of 100s.

DISPLAY

These three keys select the form in which the results of a measurement will be displayed. All keys can be operated at any time and light when activated. Only one key can be activated at a time. One of the three will always be lit.



Gives a Cartesian display in the form a + jb

	a	b
e.g.	+ 4.00V	+ 3.00V

Gives a Polar display in the form R, θ

e.g. + 5.00V + 323.2 DEG

Gives a Log Polar display in the form 20 Log_{10} R, θ°

e.g. +114dB + 323.2 DEG

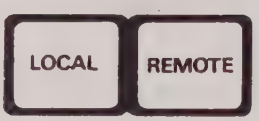
When taking measurements in the X and Y modes, the reference level is 10μV so that the display indicates either

$$20 \text{ Log}_{10} \frac{|X|}{10\mu V} \quad \text{or} \quad 20 \text{ Log}_{10} \frac{|Y|}{10\mu V}$$

In the Y/X mode where R represents $\frac{|Y|}{|X|}$ and θ° represents $(\theta y - \theta x)^{\circ}$ the display indicates

$$20 \text{ Log}_{10} \frac{|Y|}{|X|} (\theta y - \theta x)^{\circ}$$

CONTROL



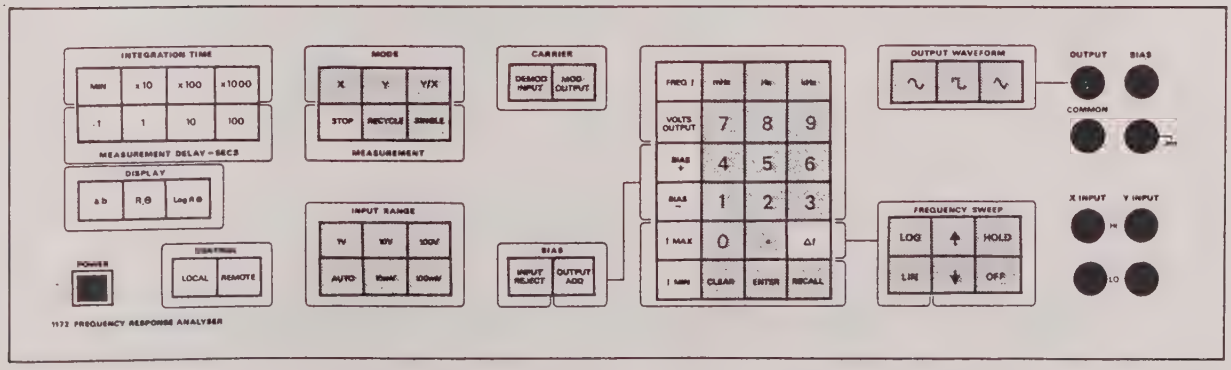
The instrument can be controlled either locally by activating the touch keys by hand or remotely by an external equipment (e.g. a computer) giving instructions via the appropriate interface board.

These keys select local or remote control. Each key lights when activated, but only one can be activated at a time. One key will always be lit. It is not possible to change from LOCAL to REMOTE control while RUN is displayed.

When activated the instrument can be controlled by means of the front panel keys only.

Inhibits the operation of most front panel keys and allows the instrument to be programmed remotely. Activating REMOTE will not in itself affect a measurement currently in progress. Once that measurement has been completed, however, further measurements can be initiated by external instructions only.

The shaded keys can not be operated while the REMOTE key is activated.



As each remote instruction is given the appropriate front panel touch key will light up, thus allowing the user to monitor operation continuously.

MODE

These keys select the type of measurement to be made. They can be operated one at a time only and each lights when activated. One of the three will always be lit. The keys can not be activated while RUN is lit on the display.

Programs the instrument to measure the amplitude of the signal applied to the X input terminals and its phase relative to the open circuit generator output signal. The result is displayed as soon as RUN goes out.

Programs the instrument to measure the amplitude of the signal applied to the Y input terminals and its phase relative to the open circuit generator output signal. The result is displayed as soon as RUN goes out.

In this mode the amplitudes of both the X and Y input signals are measured together with their phases relative to the open circuit generator output signal. The instrument then computes the ratio of the amplitude of the Y input to the X input and the phase difference between the two signals. The result is displayed as soon as RUN goes out.

Since the X and Y input signals are measured separately, the measurement time is doubled when used in this mode.

Once measured, the values of X, Y and Y/X are stored. The user can re-examine any or all these values simply by activating the appropriate mode key.

The above method measures the ratio Y/X directly. If preferred, the X and Y input signals can be selected and measured separately (using the X and Y keys as appropriate). Ratio Y/X can then be computed and displayed simply by activating the Y/X key.

MEASUREMENT

These keys are used to start or stop one single measurement or a series of repeated measurements. Only one key can be activated at a time and each lights when activated.

If this key is activated during a measurement sequence, the RECYCLE or SINGLE key will go out and the measurement will be terminated *immediately*. Because this measurement has ended prematurely, integration will be incomplete and a valid result will not be obtained. Hence, INVALID is displayed indicating that the results should be ignored.

STOP can be activated at all times including during REMOTE operation.

The STOP condition can be cancelled by activating either the RECYCLE or SINGLE key.

Initiates one measurement only.

Initiates a series of measurements. These measurements will continue until RECYCLE is cancelled either by activating the STOP key or, more usually, by activating SINGLE. In this latter case, the instrument will finish the measurement currently in progress and then wait for another measurement to be initiated.

It is not possible to alter the parameters of the output signal unless RECYCLE is first cancelled.

Both RECYCLE and SINGLE keys can be activated while RUN is lit on the display and operation can be changed from RECYCLE to SINGLE or vice versa while a measurement is in progress without invalidating any results.

INPUT RANGE

Five input voltage ranges can be selected manually by activating any one of five keys. Not more than one range can be selected at a time. If AUTO is activated, the instrument will itself select the optimum range on which to measure its input.

Each key lights when activated and one will always be lit. When autoranging, two keys will be lit simultaneously – AUTO and one other. Range can not be changed while RUN is being displayed.

When the input reaches approximately 2½ times the nominal voltage range (e.g. 250mV rms on the 100mV range), OVERLOAD will be displayed. Although a maximum of three times the nominal range can be displayed results are not valid if OVERLOAD is lit. In this event, a higher voltage range must be selected.

Note: The actual input voltage at which an overload is indicated will vary from instrument to instrument. Also,at frequencies greater than 1kHz,overload will occur at approximately 1½ times nominal range.

WARNING: The maximum input voltage that may safely be applied to the input terminals is 250V rms.

Selects the 10mV range. Voltages up to a nominal 25mV rms can be measured using this range.

Selects the 100mV range. Voltages up to a nominal 250mV rms can be measured using this range.

Selects the 1V range. Voltages up to a nominal 2.5V rms can be measured using this range.

Selects the 10V range. Voltages up to a nominal 25V rms can be measured using this range.

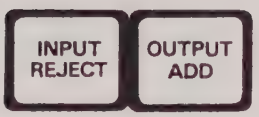
Selects the 100V range. Voltages up to a nominal 250V rms can be measured using this range.

Selects auto range. When a measurement is initiated, the 10mV input range is automatically selected. The measurement will continue on this range unless the input voltage exceeds 25mV. At this instant, the measurement will be terminated and a second measurement attempted on the next (100mV) range. This procedure will repeat until the optimum range has been selected and the measurement completed satisfactorily.

The key corresponding to the selected range will light as well as the AUTO key. Hence, when auto-ranging, two keys will be lit simultaneously enabling the user to see which range has been selected. If the output frequency is low enough it will be possible to watch the instrument step through the ranges before finally settling on the optimum range.

AUTO can be cancelled by activating any of the five range keys – even if that key is already lit.

BIAS

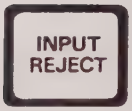


A dc bias can be made available at the output terminals. If required, this can be added in series with the ac output signal. If applied to the input system, dc bias in the signal being measured may cause undesirable effects.

These keys control both the output bias and the rejection of input bias. Both keys light when activated and may be selected either individually or together providing that RUN is not lit on the display.

The level of dc bias is programmed using the keyboard but will not appear at the output terminals until this key is activated. Bias can be switched off by touching the key a second time when the lamp will go out.

(Refer also to Output Terminals)



In a conventional instrument signals containing large dc components can overload the input stages necessitating the selection of a less sensitive range and degrading measurement resolution. Consider, for example, a 10V ac signal with a dc bias of 100V. Without the bias, the ac could be measured on the 10V range and displayed as 10.00V – a resolution of 10mV or 0.1%. With the bias present, however, the 100V range would have to be used and the ac displayed as 010.0V – a resolution of only .1V or 1%.

This instrument is able to reject dc thus enabling small ac signals to be measured with optimum resolution even when a large dc bias is present. This is achieved by an automatic process during which two seperate measurements are made. The first measurement determines the amplitude of the bias. This is then backed off by an internally generated dc. The remaining as component of the input signal is then measured on the appropriate input range in the normal way.

The amplitude of dc it is possible to reject is at least 10 times greater than the input range selected with the exception of the 100V range which is limited by the 500V insulation specification. Normally only one range improvement is given in practice.

Since two measurements are made more time is required to obtain a result when the INPUT REJECT facility is used. Further, the dc will usually be considerably larger than the ac signal and the two measurements will have to be made using different input voltage ranges. Hence AUTO range must always be selected in conjunction with INPUT REJECT.

When the INPUT REJECT key is activated, the dc in the input signal will automatically be rejected within the limits so far discussed. If the key is touched a second time, the lamp will go out and bias rejection will be switched off.

CARRIER

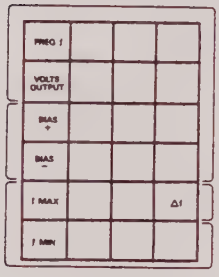
These keys are only used in conjunction with an 1184 Mod/Demod Unit. The user should check that both lights are extinguished when an 1184 is not fitted, otherwise an INVALID display will result.

Full details of the functions of these keys and their uses are given in Section 7 - 1184 Mod/Demod Unit.

KEYBOARD

The keys may be considered in two groups: those used for monitoring purposes which simply select various output parameters without affecting the output waveform: those used to set up or program the output signal.

MONITORING KEYS



Seven keys select various basic parameters of the output signal. Each key lights when activated and the extreme right-hand display shows the magnitude of the parameter selected. By activating the keys in turn and watching this display, the main characteristics of the existing output signal can be monitored – even while measurements are in progress.

Any parameter can be altered by activating the appropriate key and then inserting the required new data. This can be done only after a measurement has been completed.

These keys may be activated at any time and in any order but it is not possible to activate more than one key at a time. One of the seven will always be lit.

The parameters that can be selected are as follows:

OUTPUT FREQUENCY

The range extends from .1000mHz up to 9.999kHz.

OUTPUT VOLTAGE

The range extends from 0.010V up to 9.990V.

For sine and square waveforms the display shows the rms value. For a triangular waveform the peak value is displayed.

POSITIVE BIAS

A positive dc bias which can either be added in series with the ac output waveform or used on its own. The range extends from +0.01V up to +9.99V

NEGATIVE BIAS

A negative dc bias which can either be added in series with the ac output waveform or used on its own. The range extends from -0.01V up to -9.99V

MAXIMUM SWEEP FREQUENCY

The upper limit of a frequency sweep.

MINIMUM SWEEP FREQUENCY

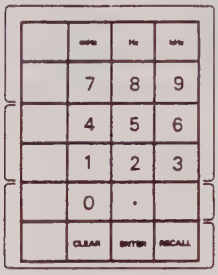
The lower limit of a frequency sweep.

FREQUENCY INCREMENT

Used only when the output frequency is being swept between the limits f_{min} and f_{max}. During logarithmic sweeps, the display will show the number of increments made in each decade. During linear sweeps, the display will show the actual increment in mHz, Hz or kHz.

PROGRAMMING KEYS

The following keys can be activated only when RUN is not showing on the display.



CLEAR

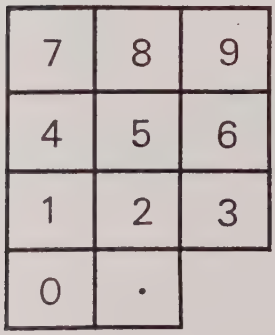
When a parameter is selected its existing value is displayed. Before fresh data can be inserted, the display must be set to 0000 by activating CLEAR. When activated this key does not light but ENTER appears on the display.

Data can be inserted only while ENTER is being displayed and the only way to write ENTER into the display is to activate the CLEAR key. Hence, even though the display may already be showing 0000, CLEAR must still be activated.

It is important to realise that only the *display* is affected by the CLEAR key and that the output signal remains unchanged.

DIGITS

After clearing the display, new data can be programmed using the following keys. None of these keys lights when activated since the display will show the range and digits as they are inserted. Once again it should be noted that the output signal will remain unaltered even though the display changes.



A maximum of four digits and a decimal point can be programmed. The first digit to be inserted is always the most significant (extreme left). Once all four digits have been programmed they can be "overwritten" by repeatedly operating the keys.

FREQUENCY RANGE

On the kHz range only, the decimal point is automatically inserted after the first (most significant) digit as soon as the ENTER key is activated. This limits the maximum frequency to 9.999kHz.

On the mHz and Hz ranges, a decimal point must be inserted in the appropriate place when programming the frequency.

RECALL

If, say, the FREQ f key has just been activated, the display will show the frequency of the existing output signal. As the digit keys are then activated in order to write in a new frequency, the display will change and show the new digits as they are programmed. Should the user then require to re-check the existing output frequency the newly programmed digits can be cancelled and cleared from the display by activating the RECALL key. The display will then again show the frequency of the existing output signal.

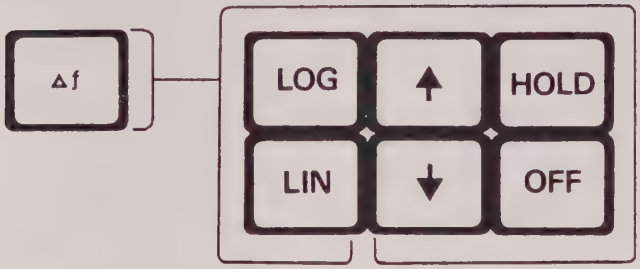
This applies to all the parameter keys – not merely the FREQ f key – but is valid only if the new data has not been entered.

Note: Existing data can also be recalled by touching the parameter key a second time. For example, if output voltage is being programmed, (the VOLTS OUTPUT key having been activated) the existing output can be recalled by touching VOLTS OUTPUT again.

ENTER

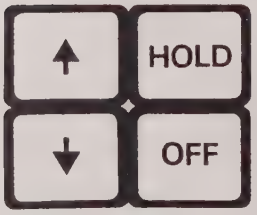
When data has been programmed, it can be entered by activating ENTER providing that RUN is not lit on the display. The output signal will change in accordance with the data entered and the new data will be displayed. This key does not light when activated but the ENTER legend on the display goes out.

FREQUENCY SWEEP



The output frequency can be swept in discrete steps (increments) between two specified limits: f_{max} (the upper limit) and f_{min} (the lower limit). The frequency can be swept in an upward or a downward direction with the relationship between successive frequencies either linear or logarithmic.

These keys select the type of sweep. Each key lights when activated. One key will always be activated but both can not be activated together. Although the two types of sweep can not be selected simultaneously, the LOG and LIN increments can be written in and both stored at the same time. Hence a change from LOG to LIN increments, or vice versa, can be made during a sweep.



These keys control the direction of sweep and allow a sweep to be stopped at any instant. Each key lights when activated. One key will always be activated but not more than one can be activated at a time.

Selects a logarithmic sweep.

Selects a linear sweep.

Selects an upward sweep. The output frequency will increase from fmin up to fmax.

Selects a downward sweep. The output frequency will decrease from fmax down to fmin.

Stops the sweep of the end of the measurement in progress and holds the output at the frequency it has reached. The sweep can be continued from this point by activating the UP or DOWN keys.

Stops the sweep at the end of the measurement in progress and holds the frequency of the output signal at the point it has reached. If either the UP or DOWN key is subsequently activated, a new sweep will start from fmin or fmax as appropriate. The sweep can be continued from where it was stopped by activating the HOLD key and then the UP or DOWN key.

OUTPUT WAVEFORM

These keys select various output waveforms. Only one key can be activated at a time. Each key lights when activated and one will always be activated. No keys can be activated while RUN is being displayed.

Note: The output waveform can be switched off only by programming an output voltage of 0V.

Selects a sine wave output whose maximum amplitude is 10V rms.

When setting the amplitude of a sine waveform the keyboard programs the rms voltage.

Selects a square wave output whose maximum amplitude is 10V rms.

When setting the amplitude of a square waveform the keyboard programs the rms voltage which is the same as the peak voltage.

Selects a triangular output whose maximum amplitude is 10V peak.

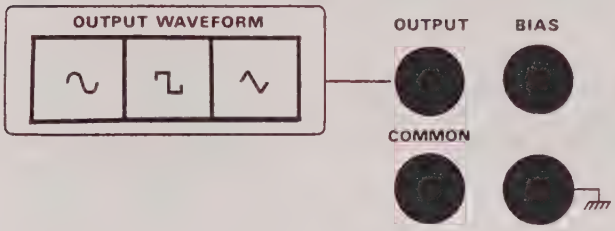
When setting the amplitude of a triangular waveform the keyboard programs the peak voltage.

Note: The correlator rejects all harmonics and measures the rms amplitude of the *fundamental component only.*

The fundamental component of a square wave is approximately 0.9 x V rms (or 0.9 x V peak).

The fundamental component of a triangular wave is approximately $\frac{1}{\sqrt{3}}$ x V peak.

OUTPUT TERMINALS



Two outputs are available: an ac waveform (sine, square or triangular wave) and a dc bias that can be added to the ac waveform or used separately if required. The bias can be switched on and off by means of the OUTPUT ADD key but the ac waveform can be switched off only by programming a 0V output on the keyboard.

Both outputs are protected against short circuits.

OUTPUT WAVEFORM

The ac waveform is available between the OUTPUT and COMMON terminals. Both terminals are floating and either may be connected directly to earth if required.

BIAS

The bias output can be used in either of two ways: as an independent dc source for biasing purposes or as a means of applying a dc offset to the ac output waveform.

Use as a dc Source

The polarity selected by the BIAS + and BIAS - keys on the keyboard refers to the polarity of the BIAS terminal with respect to COMMON. Hence, when the BIAS + key is activated the BIAS terminal will be positive with respect to COMMON or conversely, the BIAS terminal will be negative when BIAS - is activated.

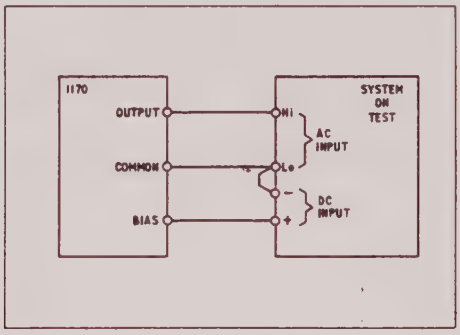


Fig. 2.11 The system on test requires separate ac and dc inputs. These are obtained by making the connections shown.

Applying a dc Offset

When used in this way it should be noted that the polarity of the dc offset is opposite to that indicated by the BIAS + and BIAS - keys. Consequently, when the BIAS + key is activated and a positive bias programmed this will cause the ac waveform to be offset in a *negative* sense.

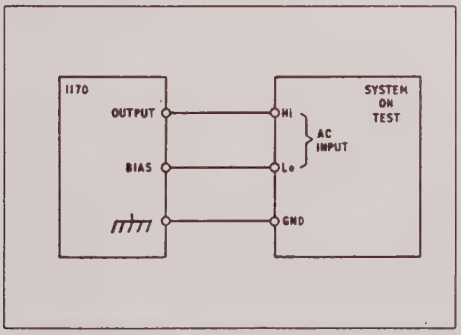


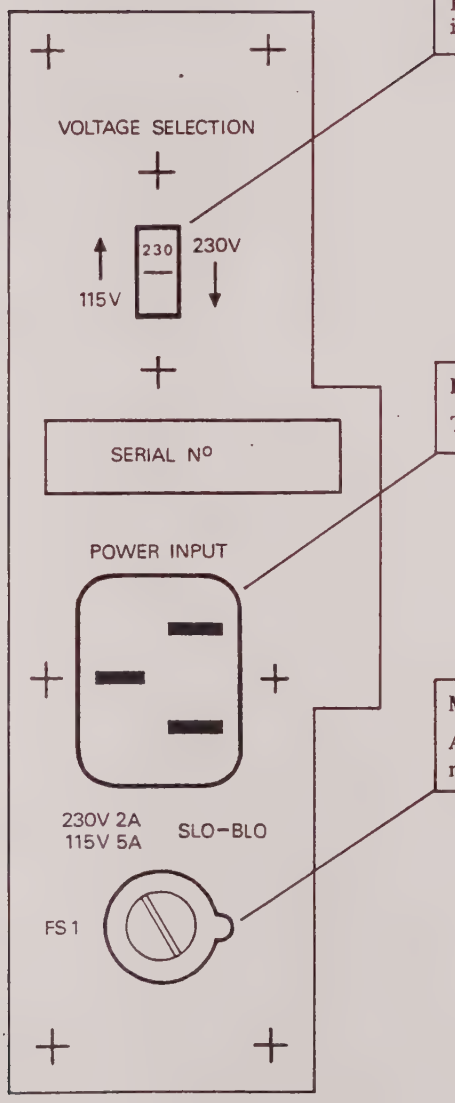
Fig. 2.12 The system on test requires an ac input signal that has a dc offset. This is obtained by making the connections shown.

INPUT TERMINALS

Two separate pairs of input terminals isolated from earth. The maximum input that can be accurately measured is 250V rms.

WARNING: The maximum input voltage that may safely be applied to these terminals is 250Vrms.

The Rear Panel



VOLTAGE SELECTION

A two position slide switch that must be set as appropriate before connecting the ac mains supply to the instrument.

POWER INPUT

Three pin ac mains input plug.

MAINS FUSE

A SLO–BLO ac mains input fuse. Note that the value must be selected according to the ac mains input.

SECTION 3 Installation, Options & Accessories

INSTALLATION

1. Connect the mains input lead socket to the POWER INPUT plug on the rear panel.

2. Adjust the rear panel VOLTAGE SELECTOR to suit the ac mains input voltage. Use the 115V position for mains voltages between 100V and 130V; the 230V position for mains voltages beween 200V and 260V.

3. Check that the mains input fuse FS1 on the rear panel is the correct value for the ac mains voltage to be applied i.e. 5A SLO-BLO for 115V operation and 2A SLO-BLO for 230V.

4. Connect the mains input lead to the ac mains supply. If it is necessary to change the type of mains input plug this must be wired up as follows.
   Connect the BROWN wire to the LIVE terminal on the plug; the BLUE wire to the NEUTRAL; the GREEN/YELLOW wire to EARTH.

5. Press the POWER push-button on the front panel – this results in certain touch-keys on the panel lighting up. Before using the instrument familiarise yourself with the control functions by reading Sections 2 and 4 of the manual.

   Slight deviations from this switch-on condition are sometimes observed. In this case, simply select the required modes before proceeding.

CAUTION: This instrument incorporates a cooling fan that requires an unrestricted flow of air for efficient operation. Avoid blocking the ventilation slots in the casing and clean the dust filters (part of the bottom cover) when necessary.

FACTORY OPTIONS

Several standard modifications to the basic instrument can be incorporated on request. Certain of these (Factory Options) are normally made before delivery but can be fitted by accredited agents at a later date if required.

OPTION 1: INPUT FILTER FACILITY

Noise is inherently rejected by the correlation process and will not normally cause difficulty when taking measurements. Where noise is very much greater than the signal being measured, however, overloading of the input stages may occur making it essential to select a less sensitive input voltage range. In extreme cases this reduction in sensitivity can make it impossible to measure a low amplitude signal.

This option makes it possible to insert a filter in series with the input signal. By selecting a suitable filter characteristic the user can then attenuate unwanted noise without significantly affecting the signal it is required to measure. One filter only is necessary - this being switched automatically to the X or Y inputs according to the MODE selected by the front panel touch keys.

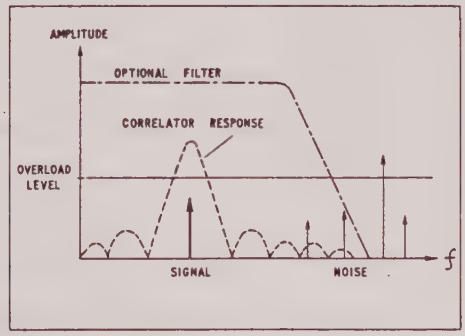


Fig. 3.1 The filtering effect of the correlation process may only partially attenuate high amplitude noise. Greater attenuation can be achieved if an external filter with a suitable characteristic is used.
Although some attenuation of the signal being measured may occur, this is insignificant when making ratio measurements since both the X and Y signals are affected equally.

CAUTION: Use of a filter will degrade the input capacitance and common mode specification of the instrument and will also introduce some phase shift. The extent of these effects depends upon the characteristics of the filter itself.

The filter used must be capable of withstanding the maximum voltage that can be applied to the X and Y input terminals (refer to 'Specification').

OPTION 2: REAR ACCESS

Option 2 (part no. A1700022) allows connection to be made, at the rear of the 1172, to the generator outputs and analyser inputs. The option is factory fitted and is intended primarily for instruments which are rack mounted.

The rear access connections are brought out on a 15 way 'D' series connector, and a mating plug is supplied. The front panel terminals are left connected and can be used if the rear access connector is not in use.

WARNING: Care should be taken not to touch the front panel terminals when high voltage signals are applied to the rear access connector.

1172 Specification Changes

When an 1172 is fitted with a rear access option the specification of the instrument is altered in the following respects:

GENERATOR

COMMON TERMINAL ISOLATION

Common to Ground: Capacitance <400pF

ANALYSER

INPUT SYSTEM

Impedance (X and Y): 1MΩ ±2% in shunt with 120pF (nominal)

LO Terminal to ground: Capacitance <350pF

ISOLATION

Between Input Channels: For 1kΩ across input, 90dB up to 99.99Hz

Rejection, Common Mode: For 1kΩ imbalance, 140dB at dc, 55dB at 50Hz

1188 Test Module: f max = f min x 100

Rear Access Connector Details

The pin functions of the rear access connector are as follows:

Pin	Function		
1	Output		
9	Common (Output)	Generator Outputs	
2	Bias		
10	Common (Bias)		
8	X Input Hi		
15	X Input Lo	Analyser Inputs	
7	Y Input Hi		
14	Y Input Lo		
5	Relay Unit Out Hi	Normally linked by	Input Filter Option – remove
6	Analyser Input Hi	LKB on 1170 pcb 24	links LKA and LKB on 1170 pcb 24 to use. See circuit
12	Relay Unit Output Lo	Normally linked by	diagram 20 in 1170 Technical
13	Analyser Input Lo	LKA on 1170 pcb 24.	Manual.
3	Chassis Earth		
11	Chassis Earth		
4	Not used		

Mating Plug Part Numbers

Solartron Part No.	Manufacturers Part No.	Description
351315040	DA - 15P	15 way plug
354004460	DA - 51220-1	slide lock assembly
354004470	DA - 51211-1	plastic right angle shell

Use of the 1188 Test Module with the Rear Access Option

With a rear access option fitted to an 1172, the 1188 Test Module can still be used. But the increase in input capacitance, due to the rear access option, causes the phase shift of the test module to depart slightly from 90° at the top end of the frequency range. Therefore *f* MAX should be limited to *f* MIN x 100

When the 1188 Test Module is being used the rear access socket should not be connected to any external cabling.

OPTION 3: 10Ω OUTPUT IMPEDANCE

The normal output impedance of 200Ω can be modified to 10Ω if required. The output current is limited, however, as stated in the technical specification (Section 6 of the manual), and any attempt to draw a current greater than that specified will result in distortion of the output voltage waveform.

OPTION 4: ALTERNATIVE PRESENTATION OF PHASE ANGLE

Phase angles are normally measured in a clockwise direction and presented as positive angles. If preferred, phase angles can be measured in an anti-clockwise direction but still presented as positive angles.

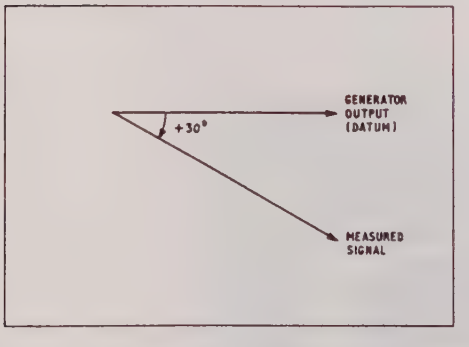


Fig. 3.2 The 30° lagging phase angle is normally shown as +30° in Polar and Log. Polar displays.

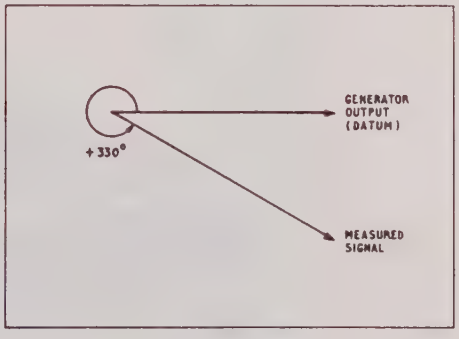


Fig. 3.3 If required, the display can be modified so that the same 30° lagging phase angle will be displayed as +330°

This affects Polar and Log. Polar displays only. Results given in Cartesian form are identical whether this option is fitted or not.

OPTION 5: MAINS INPUT CONNECTION

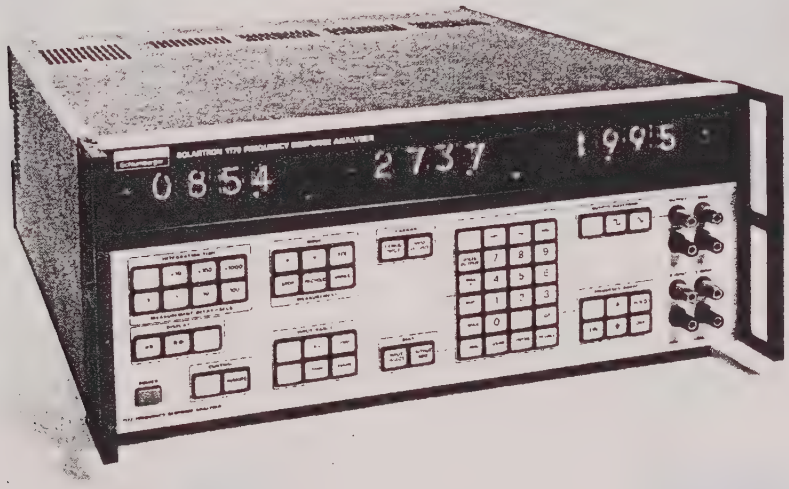
Instruments are not normally supplied with a mains input plug. If required, a mains input lead incorporating a continental (DIN) plug can be supplied on request.

CUSTOMER OPTIONS

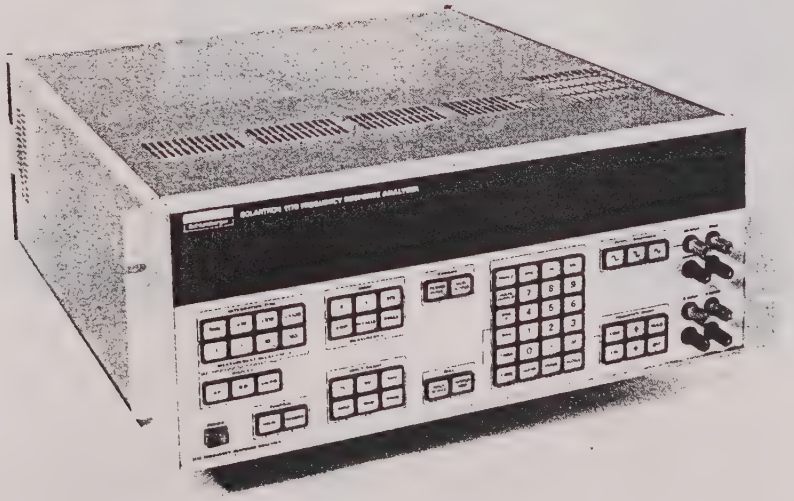
The user can make certain minor alterations to the instrument without the need for outside assistance. These are simple to carry out and require no technical skill.

RACK MOUNTING

To enable the instrument to be mounted in a rack two 'ears' are supplied with the accessories. When these are fitted in place of the standard carrying handles, the instrument can be held in position in the rack by suitable retaining screws.



Undo the two screws that secure each handle and remove both handles.

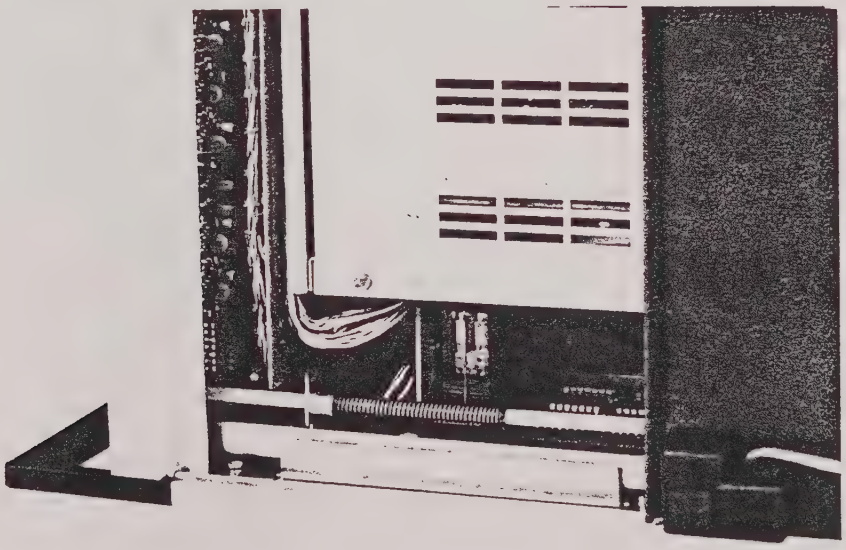


Using the same screws, fit the two ears in place of the carrying handles.

SILENT OPERATION OF THE KEYS

The audible click heard as each front panel key is touched is produced by a relay contact. If silent operation of the keys is required, this can be removed without affecting any other operating characteristics of the instrument.

Undo the two screws that secure each side panel.



Slide back both side panels and the bottom cover to expose the relay.

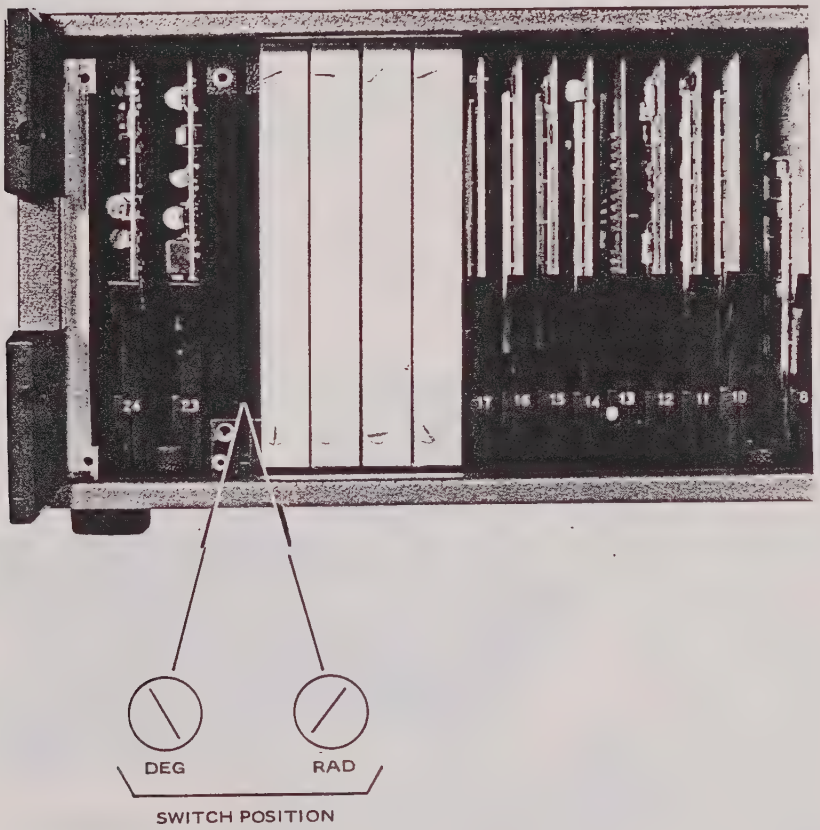
Remove the relay together with its retaining clip.

Slide the side panels and bottom cover back into position and secure with the four screws.

RADIAN DISPLAY

For both Polar and Log Polar displays, the angle θ can be given either in degrees or radians. The change from one type of display to the other is effected by altering the switch at the rear of the instrument.

Undo the four securing screws and remove the rear cover plate.



ACCESSORIES

The following accessories are supplied with all standard instruments:

Two Rack Mounting Ears
One Mains Input Lead
Three Twin Leads for connecting to the input and output terminals.
Spare mains fuses.
Spare bulbs for the touch keys.
1188 Test Module.

Changing The Touch Key Lamps

A plastic tube is supplied with the standard accessories to facilitate changing the bulbs in the touch keys. This can be done as follows.

Insert the blade of a small screwdriver into the groove provided and prise off the touch key moulding.

Use the tube to fit the replacement bulb.

Push one end of the plastic tube firmly onto the bulb and then unscrew and remove the bulb from the touch key assembly.

Care must be taken when replacing lamps in these keys. A metal deposition on the back of the glass cover forms the touch plate. This is connected to the circuit by means of the spring clips which also form the cover securing clip. Care must, therefore, be taken that the springs are not distorted and that good contact is made with the plate upon replacement. The contact clip on the touch button cover must be flush with the inner side.

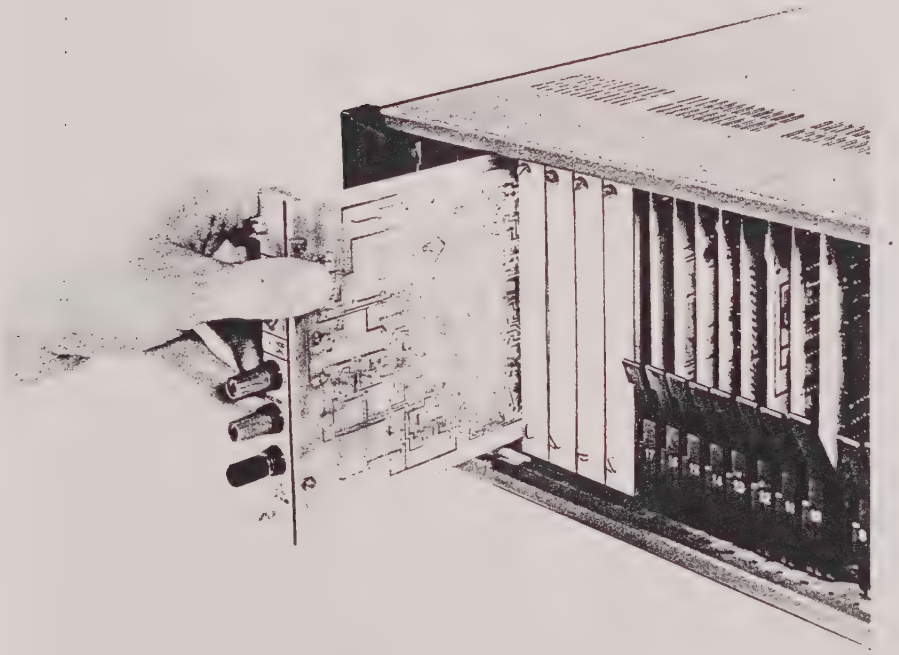
FITTING EXTENSION UNITS

Extension units are inserted as required at the rear of the instrument.

Undo the four securing screws and remove the rear cover plate.

Each Extension Unit has a unique position in the main instrument. To determine the relevent position for a particular Extension Unit refer to the 1170 Peripherals Operating Manual.

Undo two securing screws and remove the blanking plate from the position in which the Extension Unit is to be inserted. The blanking plate may now be discarded.



Insert the Extension Unit into the main instrument and when fully home tighten the two retaining screws to secure it in position.

Fit the rear cover plate.

SECTION 4 Using The Controls

INTRODUCTION

The rules to be observed when inserting data and the order in which keys should be activated are illustrated in the following examples. Some simple measurement sequences are also given.

Reference should also be made to 'The Display and Controls' for a detailed description of the functions of individual keys.

GENERAL SETTING UP PROCEDURE

Although it is possible to activate the keys in almost any order, the following procedure suggests a logical method of setting up the instrument to take a measurement.

This is a generalised procedure. More specific instructions - particularly concerning the operation of the keyboard - are given in subsequent paragraphs.

Switch On

1. Press the POWER push button.
2. Check that the LOCAL key is lit.

Set up the Output Signal

1. Program the OUTPUT FREQUENCY.
2. Program the OUTPUT VOLTAGE.
3. Select an OUTPUT WAVEFORM.

If required

4. Program a BIAS VOLTAGE and select OUTPUT ADD.
5. Set up the required SWEEP conditions.

Connect the System to be tested

1. Connect the OUTPUT TERMINALS to the input of the system to be tested.

Set up the Analyser

1. Connect the output of the system under test to the INPUT TERMINALS.
2. Select the INTEGRATION TIME.
3. Select the required measurement MODE.
4. Select either AUTO or the appropriate INPUT RANGE.

If required

5. Select INPUT REJECT.
6. Select a MEASUREMENT DELAY.

Select the Display

1. Select the required DISPLAY.

Initiate a Measurement

1. Select RECYCLE or SINGLE.

THE KEYBOARD

Beginning at the top left of each page and reading downwards, the touch keys are illustrated in the order in which they should be activated. The display that will be seen as each key is activated is shown adjacent to that key together with any explanatory text.

As a general rule, it is recommended that data be programmed in the following sequence:

1. Select the parameter to be programmed (FREQ f, VOLTS OUTPUT, BIAS +, BIAS -, f_{max}, f_{min} or Δf).
2. Activate the CLEAR key.
3. Program the required digits and, if necessary, a decimal point.
4. Program the required range (when setting up a frequency only).
5. Activate the ENTER key.
6. Check on the keyboard display that the correct data has been programmed.

NOTE: Data cannot be programmed while a measurement is in progress. Hence, before attempting to insert data ensure that RUN is not being displayed.

The internal states of some instruments are set correctly only when a measurement is taken. These states may affect the results of the first measurement. Therefore, after switch-on, it is recommended that a single measurement is preformed under the following conditions:

Bias: INPUT REJECT
Volts Output: CLEAR, ENTER
Freq. f: CLEAR, 10.0Hz, ENTER
Mode: Y/X
Measurement: SINGLE

On completion of this measurement the instrument can be used as desired.

Programming Output Frequency

Example 1: Standard method of programming frequency.

Key Activated	Keyboard Display	Notes
FREQ f		The display will show the frequency of the main output signal. This key will light.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
.	ENTER 1.000 mHz	
2	ENTER 1.200 mHz	
3	ENTER 1.230 mHz	
4	ENTER 1.234 mHz	
Hz	ENTER 1.234 Hz	
ENTER	1.234 Hz	The frequency of the main output signal will change. ENTER goes out.

When the CLEAR key is activated, the mHz range is automatically selected.

The output signal does not change until the ENTER key is activated.

CAUTION: When the POWER push button is pressed to switch the instrument on, the generator output is automatically set to 0V at 0Hz. This is an admissable condition that will cause no ill effects. At all other times, however, undesirable transients may occur if the user enters a frequency of 0Hz when the output voltage is not 0V and this condition is to be avoided.

Example 2: On the mHz and Hz ranges, the decimal point must be inserted by the user.

Key Activated	Keyboard Display	Notes
FREQ f		The display will show the frequency of the main output signal. This key will light.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
2	ENTER 1200 mHz	
.	ENTER 12.00 mHz	
3	ENTER 12.30 mHz	
4	ENTER 12.34 mHz	
Hz	ENTER 12.34 Hz	
ENTER	12.34 Hz	ENTER goes out.

Programming Output Frequency

Example 3: On the kHz range only the decimal point is pre-determined and can not be inserted by the user.

Key Activated	Keyboard Display	Notes
FREQ f		The display will show the frequency of the main output. This key will light.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
2	ENTER 1200 mHz	
.	ENTER 12.00 mHz	
3	ENTER 12.30 mHz	
4	ENTER 12.34 mHz	
kHz	ENTER 1.234 kHz	
ENTER	1.234 kHz	ENTER goes out.

As soon as the kHz key is activated the decimal point is automatically positioned after the first (most significant) digit.

Example 4: Any zeros programmed before the decimal point are ignored in order to give maximum resolution.

Key Activated	Keyboard Display	Notes
FREQ f		The display will show the frequency of the main output signal. This key will light.
CLEAR	ENTER 0000 mHz	
0	ENTER 0000 mHz	The display will not change.
.	ENTER .0000 mHz	
1	ENTER .1000 mHz	
2	ENTER .1200 mHz	
3	ENTER .1230 mHz	
4	ENTER .1234 mHz	
ENTER	.1234 mHz	ENTER goes out.

Programming Output Frequency

Example 5: The format of some entries will be changed automatically on the mHz and kHz ranges.

Key Activated	Keyboard Display	Notes
FREQ f		This key will light.
CLEAR	ENTER 0000 mHz	
0	ENTER 0000 mHz	The display will not change.
.	ENTER .0000 mHz	
1	ENTER .1000 mHz	
2	ENTER .1200 mHz	
3	ENTER .1230 mHz	
4	ENTER .1234 mHz	
Hz	ENTER .1234 Hz	
ENTER	123.4 mHz	ENTER goes out.

Although it is quite permissible to program a frequency of .1234Hz this will be entered and displayed as 123.4mHz.

Programming Output Frequency

Example 6: Because of the fixed decimal point when kHz is activated, 1.234kHz is entered instead of .1234kHz.

Key Activated	Keyboard Display	Notes
FREQ f		This key will light.
CLEAR	ENTER 0000 mHz	
.	ENTER .0000 mHz	
1	ENTER .1000 mHz	
2	ENTER .1200 mHz	
3	ENTER .1230 mHz	
4	ENTER .1234 mHz	
kHz	ENTER 1.234 kHz	
ENTER	1.234 kHz	

Programming Output Frequency

Example 7: If more than four digits are programmed "over writing" will occur.

Key Activated	Keyboard Display	Notes
FREQ *f*		This key will light.
CLEAR	ENTER 0000 mHz	
0	ENTER 0000 mHz	The display will not change.
.	ENTER .0000 mHz	
1	ENTER .1000 mHz	
2	ENTER .1200 mHz	
3	ENTER .1230 mHz	
4	ENTER .1234 mHz	
5	ENTER .5234 mHz	
6	ENTER .5634 mHz	
ENTER	.5634 mHz	

Programming Output Frequency

Example 8: A zero can not be inserted as the first digit. If this is attempted an incorrect frequency may be entered.

Key Activated	Keyboard Display	Notes
FREQ *f*		This key will light.
CLEAR	ENTER 0000 mHz	
0	ENTER 0000 mHz	The display will not change.
.	ENTER .0000 mHz	
0	ENTER .0000 mHz	The display will not change.
0	ENTER .0000 mHz	The display will not change.
1	ENTER .1000 mHz	
Hz	ENTER .1000 Hz	
ENTER	100.0 mHz	

The frequency of 0.001Hz must be programmed as 1.000mHz.

Programming Output Voltage

Example 1: Standard method of programming the output voltage.

Key Activated	Keyboard Display	Notes
VOLTS OUTPUT		The display will show the amplitude of the main output signal. This key will light.
CLEAR	ENTER 0.000 V	The decimal point is fixed.
1	ENTER 1.000 V	
.	ENTER 1.000 V	
2	ENTER 1.200 V	
3	ENTER 1.230 V	
0	ENTER 1.230 V	
ENTER	1.230 V	

A decimal point is inserted into the display as soon as the VOLTS OUTPUT key is activated and its position can not be altered by the user. The programming of the decimal point illustrated in this procedure is included merely in order to establish a consistent routine for using the keyboard and may be omitted if preferred.

Programming Output Voltage

Example 2: It is not possible to program an output of less than 10mV.

Key Activated	Keyboard Display	Notes
VOLTS OUTPUT		This key will light
CLEAR	ENTER 0.000 V	
0	ENTER 0.000 V	
.	ENTER 0.000 V	
0	ENTER 0.000 V	
0	ENTER 0.000 V	
9	ENTER 0.009 V	
ENTER	0.000 V	

Voltages of less than 10mV are entered as 0V.

Programming Output Voltage

Example 3: The maximum resolution for outputs of less than 1V is 1mV.

Key Activated	Keyboard Display	Notes
VOLTS OUTPUT		This key will light
CLEAR	ENTER 0.000 V	
0	ENTER 0.000 V	
.	ENTER 0.000 V	
1	ENTER 0.100 V	
2	ENTER 0.120 V	
3	ENTER 0.123 V	
ENTER	0.123 V	

Programming Output Voltage

Example 4: The maximum resolution for outputs between 1V and 10V is 10mV.

Key Activated	Keyboard Display	Notes
VOLTS OUTPUT		This key will light.
CLEAR	ENTER 0.000 V	
1	ENTER 1.000 V	
.	ENTER 1.000 V	
2	ENTER 1.200 V	
3	ENTER 1.230 V	
4	ENTER 1.234 V	
ENTER	1.230 V	

Although the final (least significant) digit can be programmed it will not be entered.

Programming Bias

Key Activated	Keyboard Display	Notes
BIAS + or BIAS −		The display will show the amplitude of the bias voltage previously programmed.
CLEAR		
1	ENTER 1.00 V	
.	ENTER 1.00 V	
4	ENTER 1.40 V	
9	ENTER 1.49 V	
ENTER	1.49 V	
OUTPUT ADD	1.49 V	This key will light. The programmed dc bias will appear at the bias terminal.
OUTPUT ADD	1.49 V	Operating this key for the second time switches off the bias. The key will go out.

A decimal point is inserted into the display as soon as the BIAS + or BIAS - key is activated and its position can not be altered by the user. The programming of the decimal point illustrated in this procedure is included merely in order to establish a consistent routine for using the keyboard and may be omitted if preferred.

Correcting Programming Errors

If an error is made when using the keyboard the display should be cleared and the data then entered correctly.

Example 1: It is proposed to enter a frequency of 1.200mHz but a frequency of 1.700mHz is programmed by mistake.

Key Activated	Keyboard Display	Notes
FREQ f		This key will light.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
.	ENTER 1.000 mHz	
7	ENTER 1.700 mHz	The error is noticed at this point.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
.	ENTER 1.000 mHz	
2	ENTER 1.200 mHz	
ENTER	1.200 mHz	

FREQUENCY SWEEPS

A sweep is a series of measurements taken at defined points (spot frequencies) within a specified frequency range.

The instrument itself calculates the spot frequencies from a set of basic instructions and will carry out a sweep either automatically or step by step under the complete control of the user.

At each spot frequency the instrument takes one measurement and displays the result together with the frequency at which it was obtained. The user can thus collect a series of results that can be tabulated or plotted graphically as required.

The spacing between successive spot frequencies (the increment) can be selected to give either a linear or a logarithmic sweep.

A linear sweep is one in which the frequency is changed by a constant amount after each measurement (e.g. 15Hz, 3.25mHz, 1.6kHz etc). Hence there is a linear relationship between adjacent spot frequencies.

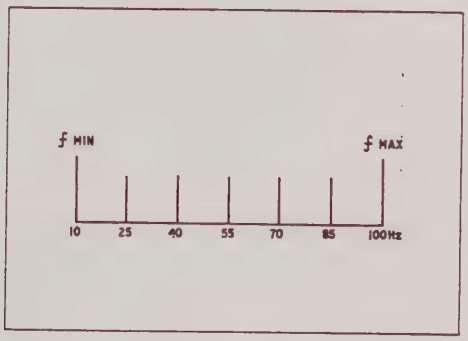


Fig. 4.1 A linear sweep with an increment of 15Hz. Measurements are made at linearly spaced intervals of 15Hz.

A logarithmic sweep is one in which a constant number of increments is made in each decade of frequency (e.g. 4, 10, 31, etc). Hence there is a logarithmic relationship between adjacent spot frequencies.

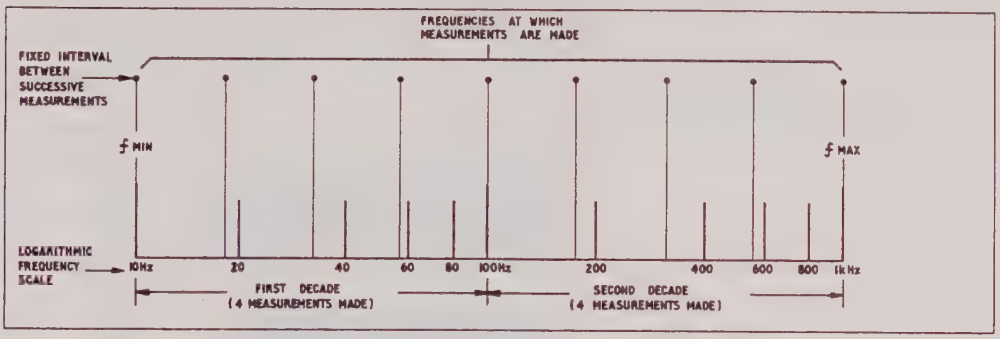


Fig. 4.2 A logarithmic sweep with four increments made in each decade of frequency.

Before a sweep can begin, the following parameters must be programmed:

f max: The upper limit of the sweep.

f min: The lower limit of the sweep.

Δ f: The increment.

Additionally, the type of sweep (i.e. LOG or LIN) and the direction of the sweep (i.e. UP or DOWN) must be selected. The setting of the sweep conditions and the use of the relevant keys is explained in the following examples.

Programming a Sweep

Example 1: A logarithmic sweep making 10 steps/decade between the limits of 1Hz and 1kHz.

Key Activated	Keyboard Display	Notes
Set the lower limit		
f MIN		This key will light. The display will show the value of fmin previously programmed.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
.	ENTER 1.000 mHz	
0	ENTER 1.000 mHz	
Hz	ENTER 1.000 Hz	
ENTER	1.000 Hz	
Set the upper limit		
f MAX		This key will light. The display will show the value of fmax previously programmed.
CLEAR	ENTER 0000 mHz	
1	ENTER 1.000 mHz	

Key Activated	Keyboard Display	Notes
.		
0		
kHz		
ENTER		

Set the logarithmic increment

LOG		This key will light. The LIN key will go out.
Δf		This key will light.
CLEAR		The decimal point is fixed in this position.
1		
0		
.		
0		
ENTER		

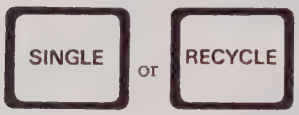
Monitor the output frequency

Select the sweep direction

This key will light. The OFF key will go out.

Program other operating conditions as required. (Integration Time, Input Range, Display etc.)

Start the sweep



When the sweep is started, the instrument will immediately set itself to the upper limit (fmax) if the DOWN key has been activated or to the lower limit (fmin) if the UP key has been activated.

If the RECYCLE key has been activated one complete sweep will be made automatically in the appropriate direction. The sweep will continue until either the upper or lower limit is reached at which point it will stop. The OFF key will then light but the instrument will continue to take measurements at this frequency unless the STOP key is activated.

If the SINGLE key has been activated the frequency will immediately change to either the upper or lower limit as appropriate and one measurement will then be made. Each time that the SINGLE key is subsequently activated the frequency will make one increment in the chosen direction and another measurement will be taken. This will continue until either the upper or lower limit is reached. At this point the OFF key will light and it will not be possible to increment the frequency although measurements can still be made.

The direction of the sweep can be changed simply by activating the UP or DOWN key as necessary – even while a sweep is in progress.

The order of programming can be changed if required, e.g. fmax can be set up before fmin.

It is not possible to carry out a sweep that has a lower limit of 0Hz. Fmin must always be set to a finite frequency.

Programming a Sweep

Example 2: A linear sweep between the limits 1mHz and 1Hz with an increment of 5mHz.

Key Activated	Keyboard Display	Notes
Set the lower limit		
f MIN		This key will light.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
.	ENTER 1.000 mHz	
0	ENTER 1.000 mHz	
ENTER	1.000 mHz	
Set the upper limit		
f MAX		This key will light. The fmin key will go out.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
.	ENTER 1.000 mHz	

Key Activated	Keyboard Display	Notes
0		
Hz		
ENTER		

Set the linear increment

LIN		This key will light. The LOG key will go out.
Δf		This key will light.
CLEAR		
5		
.		
0		
ENTER		

Monitor the output frequency

Select the sweep direction

or

This key will light. The OFF key will go out.

Program other operating conditions as required. (Integration Time, Input Range, Display etc.)

Start the sweep

or

ADDITIONAL NOTES ON SWEEPS

Upward Sweeps

The way in which an upward sweep is carried out depends upon the frequency at which the previous measurement was made.

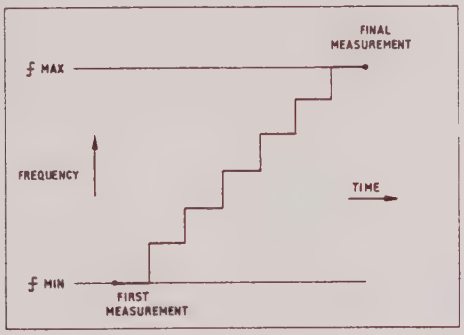


Fig. 4.3 If the previous measurement was made at a frequency equal to fmin then a subsequent sweep will start at this point and continue up to fmax in the required number of steps. A measurement is made at each frequency.

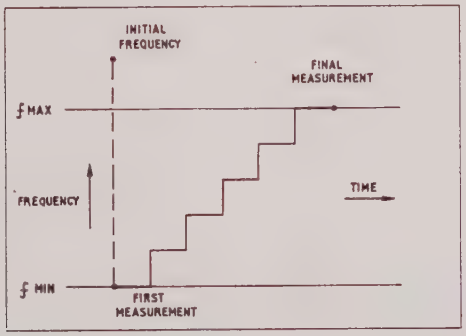


Fig. 4.4 A previous measurement may have been made at a frequency higher than fmax. When an upward sweep is next initiated the output frequency immediately returns to fmin and then steps up to fmax. A similar procedure is followed if the previous measurement was made at a frequency between the limits fmax and fmin.

In general, at the commencement of an upward sweep, the output frequency will step from its current value to f_{min} and continue up to f_{max} in the required number of steps.

Downward Sweeps

The manner in which a downward sweep is carried out depends upon the frequency at which the previous measurement was made.

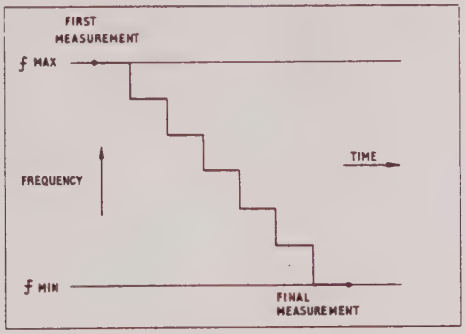


Fig. 4.5 If the previous measurement was made at a frequency equal to fmax then a subsequent sweep will start at this point and continue down to fmin.

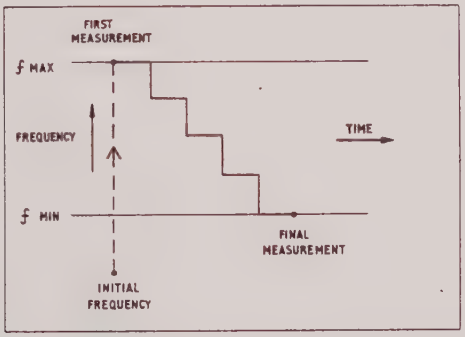


Fig. 4.6 A previous measurement may have been made at a frequency lower than fmin. When a downward sweep is next initiated the output frequency immediately returns to fmax and then steps down to fmin. A similar procedure is followed if the previous measurement was made at a frequency between the limits fmax and fmin.

In general, at the commencement of a downward sweep, the output frequency will step from its current value to f_{max} and continue down to f_{min} in the required number of steps.

Choice of Increment

The final measurement in any sweep will always be made at either fmax or fmin according to the direction of the sweep. This may mean that the last increment is different from previous ones. Consider an upward sweep for example.

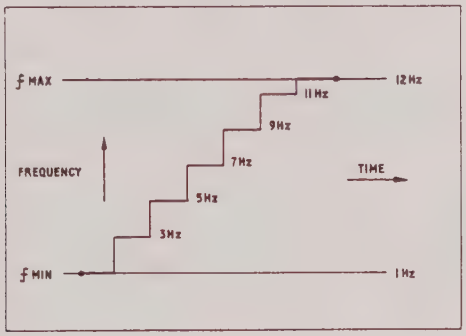


Fig. 4.7 The frequency has been arranged to increase in steps of 2Hz. However, since the sweep cannot exceed fmax the final step is limited to 1Hz.

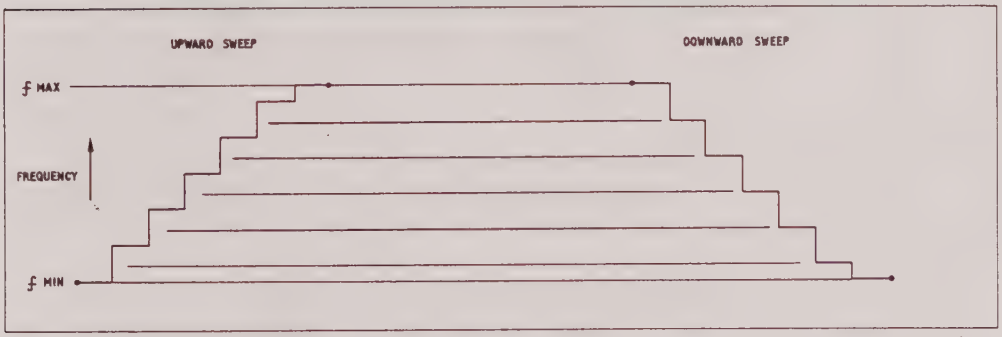


Fig. 4.8 Where the final step differs from the other increments the frequencies generated during a downward sweep will not be the same as those generated during an upward sweep. Hence different results will be obtained.

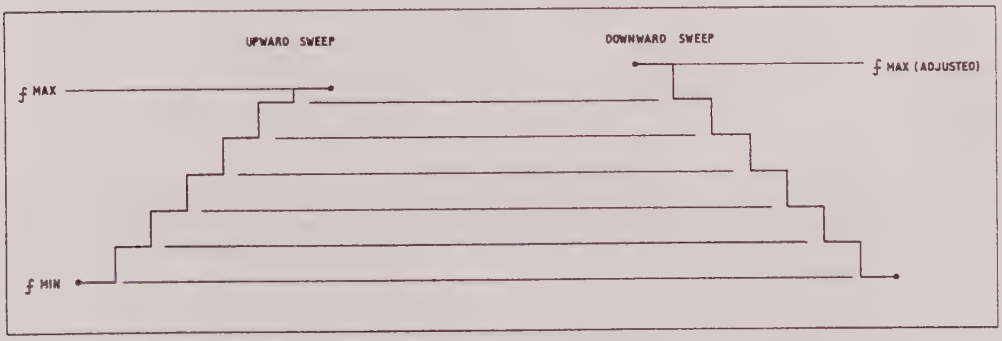


Fig. 4.9 It can be arranged for measurements to be made at the same points during both upward and downward sweeps by suitably adjusting one of the limits. A more satisfactory solution, however, is to plan the sweep so that there is a whole number of equal increments between the limits.

If necessary, a sweep may be interrupted at any point and its subsequent progress modified to suit the prevailing conditions. In most cases this can be done without actually stopping the sweep.

Changing Direction

The direction of a sweep can be changed merely by activating the UP or DOWN key as appropriate. No errors will be incurred in this process.

Changing the type of Sweep

The instrument is able to store both a linear and a logarithmic increment simultaneously. Provided that both types of increment have been programmed, it is possible to change from a linear to a logarithmic sweep (or vice versa) simply by activating the appropriate key.

This facility may be of use when investigating the behaviour of a system over a wide frequency range. Initially, because of the range of frequencies involved, it is advisable to use a coarse increment i.e. a logarithmic sweep. If a system resonance occurs at some point, it may be advantageous to change to a linear sweep having a much finer increment in order to be able to step slowly through the resonance and examine it in detail.

Slowing down the Sweep

At high frequencies where the integration time is short, results will be displayed in rapid succession and possibly leave insufficient time for the user to record them. Further, the system may require a finite settling time after each frequency increment. The user can effectively slow down the sweep by selecting a convenient measurement delay.

Holding a Sweep

A sweep can be held at any point for as long as necessary and then either continued in the same direction or reversed.

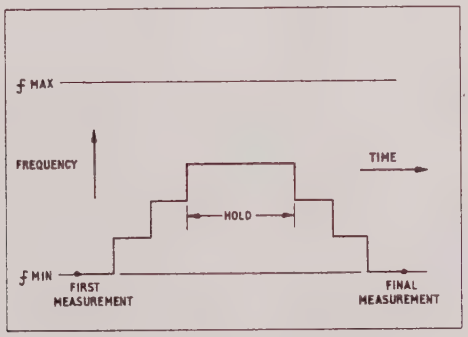


Fig. 4.10 Once the HOLD key is activated the sweep will stop and the output frequency will remain at whatever point it has reached. The sweep can be re-started by activating either the UP or the DOWN key.

If it is required to continue the sweep from the frequency at which it was stopped rather than return to fmin or fmax, the HOLD key must be activated followed by the UP or DOWN key as appropriate.

HOLD can also be used when it is required to start a sweep at a frequency other than fmin or fmax.

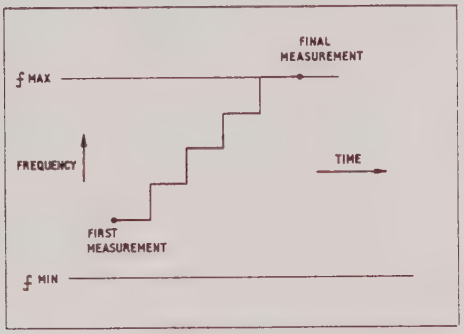


Fig. 4.11 The HOLD key can be activated prior to starting a sweep and the output frequency then set up using the keyboard. When a sweep is then initiated it will begin at this frequency and not at fmin (or fmax).

Stopping the Sweep

A sweep can be stopped at any instant by using the OFF key.

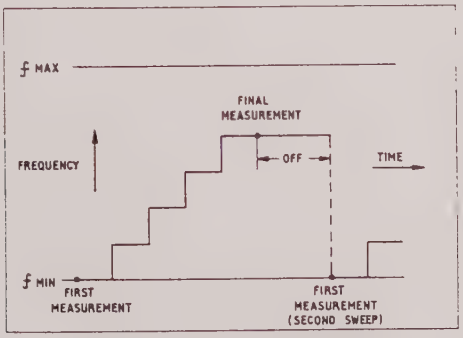


Fig. 4.12. If the OFF key is activated the sweep will stop and the output frequency will remain at whatever point it has reached. When the next sweep is initiated it will begin from fmax or fmin according to whether an upward or a downward sweep has been selected.

THE EFFECTS OF DC BIAS

When a signal has a dc bias greater in amplitude than the ac component to be measured, the choice of input voltage range is governed primarily by the bias. Although the dc is effectively ignored in all calculations, it can nevertheless degrade measurement resolution by necessitating the selection of a less sensitive range.

Where the voltage range is chosen manually, it can usually be assumed that a dc bias is present if an overload is indicated before the display has reached the normal overload level. As an example, with an ac input of 0.5V an overload will occur on the 1V range if the dc bias is greater than about 2V although the display will register only 0.5V.

Where autorange is in use, dc bias may prevent a reading from being displayed with maximum resolution. Hence, if a voltage of, say, 10mV is displayed on the 10V range then a large dc bias is almost certainly present.

If the INPUT REJECT key is activated, the effects of dc bias can be eliminated and the maximum resolution is available at all times.

It is not recommended that the INPUT REJECT key be left permanently activated. Since the instrument has to make at least two measurements - one of the bias; one of the ac signal - the time required to complete a measurement sequence is significantly longer when the bias reject facility is in use and at low frequencies this increase in the measurement time may not be acceptable. As a general rule, INPUT REJECT should be used only when resolution seems poor or at high frequencies e.g. above 1Hz. Refer also to Section 2 - Bias (Input Reject Key)

Noise can cause a similar loss of resolution which can not be improved by use of the INPUT REJECT facility.

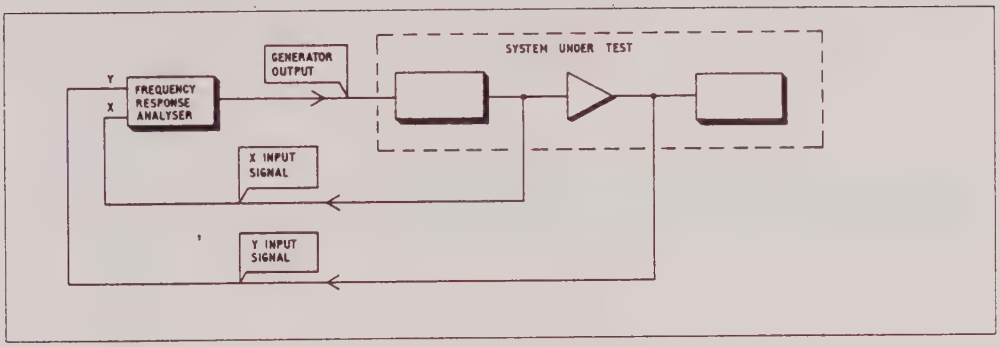


Fig. 4.15 The response of the amplifier can be found by computing the difference in amplitude between its input and output over the required frequency range.

Connect the X and Y inputs as shown.

Set up a frequency sweep to cover the required frequency range.

Key Activated	Notes
Y/X	
SINGLE or RECYCLE	As each measurement is made, ratio Y/X (gain) will be computed. If the FREQ f key is activated, the frequency at which each measurement was made will also be displayed. Hence, as the sweep progresses it will be possible to establish the relationship of gain vs frequency.

POINT TO POINT MEASUREMENTS

When analysing two inputs X and Y, the ratio Y/X will be measured directly if the Y/X key is kept permanently activated. The same result can also be obtained by using the X and Y keys to make individual measurements of the X and Y signals and afterwards activating the Y/X key.

X and Y measurements

Key Activated	Notes
	The signal at the X input terminals (X_1) is measured and the ratio Y_0/X_1 is computed where Y_0 is the previous signal at the Y input terminals. If the instrument has just been switched on Y_0 will be zero.
	The display will show the value of X_1.
	The signal at the Y input terminals (Y_1) is measured and the ratio Y_1/X_1 is computed.
	The display will show the value of Y_1.
	The display will show the ratio Y_1/X_1.
	The signal at the X terminals (X_2) is measured and the ratio Y_1/X_2 is computed.
	The display will show the value of X_2.
	The display will show the ratio Y_1/X_2.

Key Activated	Notes
X	The signal at the X terminals (X_3) is measured and the ratio Y_1/X_3 is computed.
SINGLE	The display will show the value of X3.
Y	The signal at the Y terminals (Y_2) is measured and the ratio Y_2/X_3 is computed.
SINGLE	The display will show the value of Y2.
Y	The signal at the Y terminals (Y_3) is measured and the ratio Y_3/X_3 is computed.
SINGLE	The display will show the value of Y3.
Y/X	The display will show the ratio Y_3/X_3.

Note that a particular value of X or Y can be retained and used in subsequent calculations (e.g. Y_1 is used for two calculations).

WIRE LINKS

Where the X input is the same as the generator output it may be preferable to connect the generator output terminals directly to the X input terminals and avoid the possible inconvenience of long connecting leads. Two stainless steel wire links are provided with the standard accessories for this purpose.

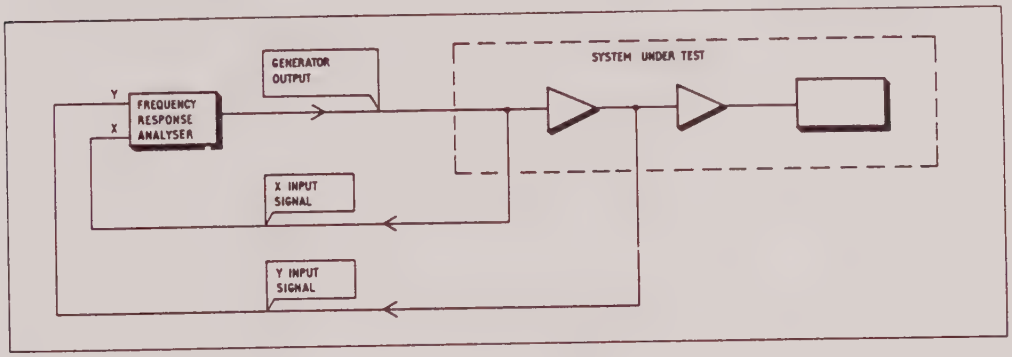


Fig. 4.16 In this example the generator output is identical to the X input signal.

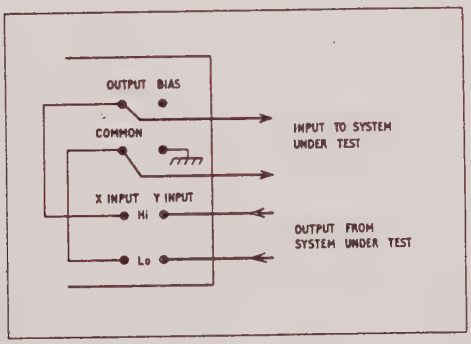


Fig. 4.17 By connecting the links as shown a point to point measurement can be made using only the Y input terminals.

SECTION 5 Functional Checks

INTRODUCTION

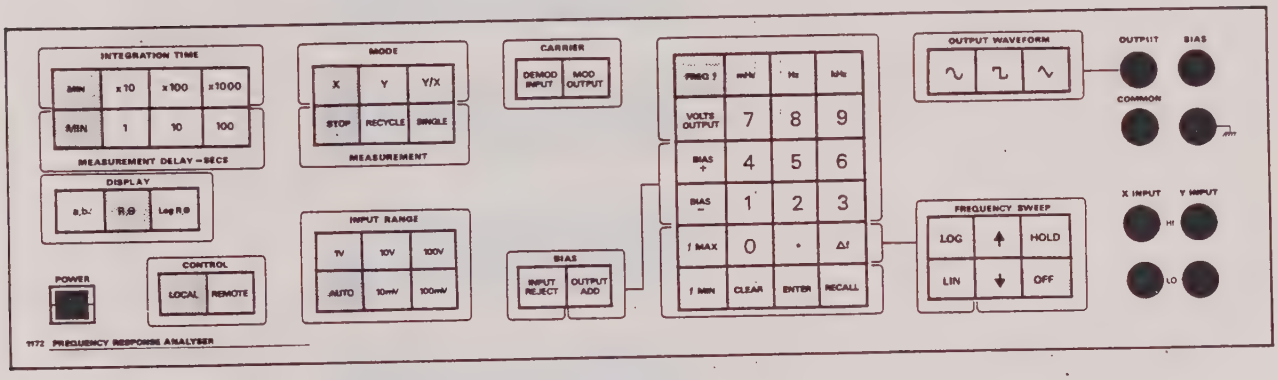
The following procedure is designed to check the operation of all front panel controls. It may be used as a preliminary check of the overall performance of the instrument when first installed.

FUNCTIONAL CHECKS

SWITCH ON

POWER

Any key shown shaded in the diagram below must be activated, if not already lit. At least one range key will be lit in addition to AUTO.



Refer also to Section 2 - The Front Panel - Power

REMOTE CONTROL

Activate the REMOTE key.

Check that it is impossible to program an output frequency.

Activate the LOCAL key.

PROGRAM AN OUTPUT FREQUENCY (e.g. 10Hz)

Key Activated	Keyboard Display	Notes
FREQ f		This key will light.
CLEAR	ENTER 0000 mHz	
1	ENTER 1000 mHz	
0	ENTER 1000 mHz	
.	ENTER 10.00 mHz	
Hz	ENTER 10.00 Hz	
ENTER	10.00 Hz	

PROGRAM AN OUTPUT VOLTAGE (e.g. 1V)

Key Activated	Keyboard Display	Notes
VOLTS OUTPUT		This key will light.
CLEAR	ENTER 0.000 V	
1	ENTER 1.000 V	
.	ENTER 1.000 V	
0	ENTER 1.000 V	
ENTER	1.000 V	

PROGRAM A POSITIVE BIAS (e.g. 3V)

Key Activated	Keyboard Display	Notes
BIAS +		This key will light.
CLEAR	ENTER 0.00 V	
3	ENTER 3.00 V	
.	ENTER 3.00 V	
0	ENTER 3.00 V	
ENTER	3.00 V	
OUTPUT ADD	3.00 V	This key will light. The dc bias will appear at the BIAS terminal.
OUTPUT ADD	3.00 V	The key will go out. The dc bias will be switched off.

PROGRAM A NEGATIVE BIAS (e.g. 8V)

Connect a suitable voltmeter or a dc coupled oscilloscope between the BIAS and COMMON terminals to measure the bias voltage.

Key Activated	Keyboard Display	Notes
BIAS −		This key will light.
CLEAR	ENTER 0.00 V	
8	ENTER 8.00 V	
.	ENTER 8.00 V	
0	ENTER 8.00 V	
ENTER	8.00 V	
BIAS +	0.00 V	This key will light and the BIAS - key will go out.
BIAS −	8.00 V	This key will light and the BIAS + key will go out.
OUTPUT ADD	8.00 V	The dc bias will appear at the BIAS terminal
OUTPUT ADD	8.00 V	This key will go out and the dc bias will be switched off.

Note that the instrument is not able to store positive and negative bias voltages simultaneously. When a positive bias is entered, any negative bias is cancelled and vice versa.

RECALL

Program an output frequency of 10Hz and then proceed as follows.

Key Activated	Keyboard Display	Notes
FREQ f		
CLEAR		
RECALL		

The same effect can be achieved by using the appropriate parameter key instead of the RECALL key.

Key Activated	Keyboard Display	Notes
FREQ f		
CLEAR		
FREQ f		

OUTPUT WAVEFORM

Program an output of 1V at 10Hz.

Connect an oscilloscope between the OUTPUT and COMMON terminals and select a range suitable for measuring the output waveform.

Key Activated	Notes
	This key will light and a 1V rms sine wave will appear on the oscilloscope (3V peak to peak approximately).
	This key will light and a 1V rms square wave will appear on the oscilloscope. (2V peak to peak).
	This key will light and a 1V peak triangular wave will appear on the oscilloscope (2V peak to peak).

MEASUREMENT

Program an output of 1V at 10Hz.

Connect the OUTPUT terminal to X INPUT HI and connect COMMON to X INPUT LO. Activate the following keys.

Take one measurement by activating the SINGLE key. The correlator display will indicate +1V with a phase angle of 0 DEG. (approximately). For more detailed performance checks refer to pages PC1 to PC10 at the rear of this volume.

Take a series of measurements by activating the RECYCLE key. The RUN indicator in the display will flash showing that repeated measurements are being made and the RECYCLE key will remain lit.

Stop the measurement by activating the STOP key.

INPUT RANGES

Program an output frequency of 10Hz.

Connect the OUTPUT terminal to X INPUT HI and connect COMMON to X INPUT LO.

Activate the following keys.

Program an output voltage of 10mV and take one measurement by activating the SINGLE key. The analyser display will indicate approximately 10.00mV with a phase angle of 0 DEG and the 10mV range key will light.

Program an output voltage of 100mV and take one measurement. The analyser display will indicate approximately 100.0mV with a phase angle of 0 DEG and the 100mV range key will light.

Program an output voltage of 1V and take one measurement. The analyser display will indicate approximately 1.000V with a phase angle of 0 DEG and the 1V range key will light.

Program an output voltage of 9V and take one measurement. The analyser display will indicate approximately 09.00V with a phase angle of 0 DEG and the 10V range key will light.

Activate the 100V range key. The AUTO key will go out and the 100V key will light. Take a measurement. The analyser display will indicate approximately 009.0V with a phase angle of 0 DEG.

DISPLAY

Program an output of 1V at 10Hz.

Connect the OUTPUT terminal to X INPUT HI and connect COMMON to X INPUT LO.

Activate the following keys.

Take one measurement by activating the SINGLE key. The analyser display will indicate approximately 1V with a phase angle of 0 DEG.

Change to a Cartesian display by activating the a,b key. The display will indicate approximately $\overset{a}{+}$ 1V and $\overset{b}{+}$ 0V.

Change to a Log. Polar display by activating the Log R, θ key. The display will indicate approximately +100dB with a phase angle of 0 DEG.

MODE

Program an output of 1V at 10Hz.

Connect the OUTPUT terminal to both the X and Y INPUT HI terminals. Connect COMMON to both the X and Y INPUT LO terminals.

Activate the following keys.

Take one measurement of the X input signal by activating the SINGLE key. The analyser display will indicate approximately +100dB with a phase angle of 0 DEG.

Activate the Y key and take one measurement of the Y input signal by activating the SINGLE key. The analyser display will indicate approximately +100dB with a phase angle of 0 DEG.

Activate the Y/X key and take one measurement of the ratio between Y and X signals by activating the SINGLE key. The analyser display will indicate approximately 0dB with a phase angle of 0 DEG.

INTEGRATION TIME

Program an output of 1V at 10Hz.

Connect the OUTPUT terminal to X INPUT HI and connect COMMON to X INPUT LO.

Activate the following keys.

Take one measurement by activating the SINGLE key. The analyser display will indicate approximately 1V with a phase angle of 0 DEG. The integration time can be checked by observing the RUN indicator on the display which, in this case, will light for approximately 0.1s.

Activate the x10 key and take one measurement. Observe the RUN indicator which will light for approximately 1s.

Activate the X100 key and take one measurement. Observe the RUN indicator which will light for approximately 10s.

Activate the X1000 key and take one measurement. Observe the RUN indicator which will light for approximately 100s.

MEASUREMENT DELAY

Program an output of 1V at 10Hz.

Connect the OUTPUT terminal to X INPUT HI and connect COMMON to X INPUT LO.

Activate the following keys.

Initiate a series of measurements by activating the RECYCLE key. Since a measurement delay of only .1s is selected, the delay between successive measurements will not be noticeable.

Activate the 1 key and observe the RUN indicator in the display. Check that the delay between successive measurements is approximately 1s. (i.e. the time for which the RUN indicator is off).

Activate the 10 key and check that the delay between successive measurements is approximately 10s.

Activate the 100 key and check that the delay between successive measurements is approximately 100s.

Stop the series of measurements by activating the SINGLE key.

BIAS REJECT

Program an output of 1V at 10Hz.

Program a bias (+ve or -ve) of 9.99V but do not activate the OUTPUT ADD key.

Connect the OUTPUT terminal to X INPUT HI and connect the BIAS terminal to X INPUT LO.

Activate the following keys.

Take one measurement by activating the SINGLE key. The analyser display will indicate approximately 1V with a phase angle of 0 DEG. Note that the 1V INPUT RANGE key is lit.

Activate the OUTPUT ADD key and take one measurement. The analyser display will again indicate approximately 1V but the input will have been measured on the 10V range. Note that the 10V INPUT RANGE key is lit.

Activate the INPUT REJECT key and take one measurement. The analyser display will indicate approximately 1V but the input will have been measured on the 1V range. Note that the 1V INPUT RANGE key is lit showing that the 9.99V dc bias has been effectively rejected.

USING THE TEST MODULE

The 1188 Test Module supplied with the accessories provides a means of checking the sweep facilities and of verifying measurement accuracy.

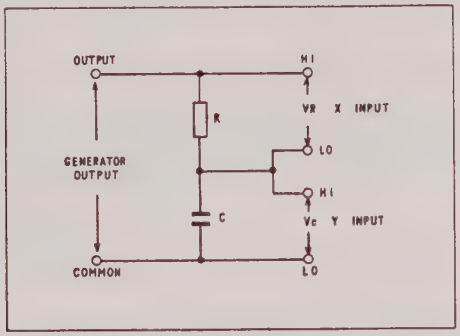


Fig 5.1 The calibration filter is a simple RC network that can be connected between the generator and analyser as shown. Much of the complex circuitry within the instrument is checked automatically when the filter is used as recommended.

CAUTION : Results given in this procedure are approximate only and will vary from instrument to instrument within the specified limits. Refer to 'Technical Specification' for full details of absolute measurement accuracy.

1. Plug the Test Module into the front panel INPUT and OUTPUT sockets. Ensure it is inserted the right way up.

2. Set up the following conditions :

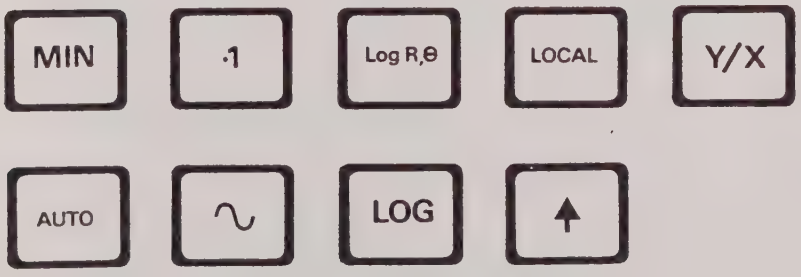
   Program an OUTPUT of 3.0V.

   Program the value of fmin printed on the Test Module.

   Program f max (i.e. f min x 10^3).

   Program a logarithmic increment of 20 frequency steps/decade.

   Activate the following keys :



   Monitor the output frequency by activating the FREQ f key

3. Start an upward sweep by activating the RECYCLE key

   The sweep parameters are such that a total of 60 measurements will be made between the limits f min and f max. During this sweep the Log R component of the analyser display will decrease from +30dB to −30dB in 1dB steps while the phase angle θ will remain constant at 90 DEG.

   Each value of R will be within ± 0.1dB of the nominal while θ will be 90 DEG ± 0.2 DEG.

4. When the sweep ends, and the OFF key lights, activate the DOWN key and initiate another sweep by activating the RECYCLE key (if the RECYCLE key is already activated, a downward sweep will begin as soon as the DOWN key is activated).

   The readings will now change from -30dB to +30dB in 1dB steps with the phase angle remaining constant at 90 DEG.

5. When the sweep ends and the OFF key lights, activate the SINGLE key to stop further measurements being taken. Activate the UP key and carry out a manual sweep by repeatedly activating the SINGLE key. Observe the display and discontinue the sweep when + 20dB is indicated.

   Y/X is now +20dB which is a voltage ratio of 10:1. If the individual amplitudes of Y and X are examined the signal at the Y input will be found to be ten times the signal at the X input.

   Change to a Polar display by activating the R, θ key. The display will indicate a ratio of +10 with a 90 DEG phase angle.

   Examine the Y input signal by activating the Y key. The display will indicate an amplitude of approximately 2.7V.

   Examine the X input signal by activating the X key. The display will indicate an amplitude of approximately 0.27V (i.e. 1/10 of Y).

6. Activate the Log R,θ and Y/X keys and continue the sweep using the SINGLE key. Observe the display and discontinue the sweep when +10dB is indicated.

   Y/X is now +10dB which is a voltage ratio of 3.162:1

   Change to a Polar display by activating the R, θ key. The display will indicate a ratio of approximately 3.162 with a phase angle of 90 DEG.

7. Activate the Log R, θ key and continue the sweep using the SINGLE key. Observe the display and discontinue the sweep when 0dB is indicated.

   Y/X is now 0dB which is a voltage ratio of 1:1. If the individual amplitudes of Y and X are now examined they will be found to be equal. Further, the phase angles will be equal but opposite.

   Change to a Polar display by activating the R, θ key. The display will indicate a ratio of unity with a phase angle of 90 DEG.

   Examine the Y input signal by activating the Y key. The display will indicate approximately +2V with a phase angle of 45 DEG.

   Examine the X input signal by activating the X key. The display will indicate approximately +2V with a phase angle of 315 DEG (i.e. -45DEG).

Change to a Cartesian display by activating the a, b key and examine the X input signal. The two components a and b will be approximately equal.

Examine the Y input signal and check that the a and b components are approximately equal.

8. Activate the Log R, θ and Y/X keys and continue the sweep using the SINGLE key. Observe the display and discontinue the sweep when -10dB is indicated.

   Y/X is now -10dB which is a voltage ratio of 1:3.162.

   Change to a Polar display by activating the R, θ key. The display will indicate a ratio of approximately +0.3162 with a phase angle of 90 DEG.

9. Activate the Log R, θ key and continue the sweep using the SINGLE key. Observe the display and discontinue the sweep when -20dB is indicated.

   Y/X is now -20dB which is a voltage ratio of 1:10.

   Change to a Polar display by activating the R, θ key. The display will indicate a ratio of +0.1 with a 90 DEG phase angle.

   Examine the Y input signal by activating the Y key. The display will indicate an amplitude of approximately 0.27V.

   Examine the X input signal by activating the X key. The display will indicate an amplitude of approximately +2.7V.

10. Activate the Log R, θ and Y/X keys and continue the sweep using the SINGLE key. Observe the display and discontinue the sweep when -30dB is indicated.

    Y/X is now -30dB which is a voltage ratio of 1:31.62.

    Change to a Polar display by activating the R, θ key. The display will indicate a ratio of approximately 31.62×10^{-3} with a 90 DEG phase angle.

SECTION 6 Technical Specification

The 1172 Frequency Response Analyser can be used 2 minutes after switch on. But, for the following specification to be relied on, the instrument should be subject to a settling period of 30 minutes (min.).

Manufacturers calibration temperature 20°C

GENERATOR

FREQUENCY

Range: 0.1mHz to 9.999kHz
Resolution: 1 in 9999
Accuracy: ±0.01% of setting

AMPLITUDE

Range: 10mV to 9.99V
Resolution: 1mV between 10mV and 999mV
10mV between 1.00V and 9.99V
Stability: 0.1% short term.

WAVEFORM

Shape: Sine, rms calibrated (peak output 14.13V max).
Square, peak calibrated
Triangular, peak calibrated.
Generation: 2000 steps/cycle ≤999.9Hz
200 steps/cycle 1kHz to 9.999kHz
Distortion: Total harmonic distortion <1% on sine wave. For frequencies between 1kHz and 2kHz there is an additional component <1.5% at 200 times the generator frequency.

OUTPUT

Impedance: 200Ω (10Ω optional)
Capability: The output terminal may be shorted to the common terminal without distortion, provided the 10Ω optional output impedance is not fitted.
Current Limit: 130mA peak

FREQUENCY SWEEP

Lower Limit: May be set to any frequency within the
Upper Limit: range 0.1mHz to 9.999kHz
Linear Increment: May be set to any frequency within the range 0.1mHz to 9.999kHz and down to 0.1μHz with reduced resolution.
Log Increment: 0.11 to 99.99 points per decade
Note: Both logarithmic and linear increments can be stored at the same time so that, for example, the increment can be changed from log to lin during a sweep.

Control:

UP	Sets direction of sweep and initiates a
DOWN	sweep if RECYCLE is selected.
HOLD	Holds the generator output at the current frequency.
OFF	Switches the sweep off.

DISPLAY Frequency, output voltage, bias, upper frequency limit, lower frequency limit, and frequency increment appear on the display when called for.

OUTPUT BIAS

Amplitude:
Range 0 to 9.99V, positive or negative.
Resolution 10mV
Output:
Impedance 200Ω (10Ω optional)
Current limit 130mA peak

COMMON TERMINAL ISOLATION

The generator and bias outputs have the same COMMON terminal which is isolated from ground.

Common To Ground:
Voltage 500V peak maximum
Capacitance < 300pF

ANALYSER

INPUT SYSTEM

Connections: Two inputs denoted by X and Y with separate HI and LO terminals. Each input is isolated from the other and from the rest of the instrument.
Input Ranges: 10mV, 100mV, 1V, 10V, 100V rms plus autorange.
Input Voltage: Maximum of 200V peak on all ranges.
Impedance (X and Y): 1MΩ ±2% in shunt with approximately 70pF

LO Terminal to Ground:
Voltage 200V peak (140V rms sine wave) maximum
Capacitance <300pF

ISOLATION

Between Input Channels: For 1kΩ across input.
>100dB up to 99.99Hz

REJECTION

Common Mode: For 1kΩ imbalance.
>140dB at dc
>60dB at 50Hz
Series Mode: >60dB at dc
>50dB for all harmonics

GENERAL

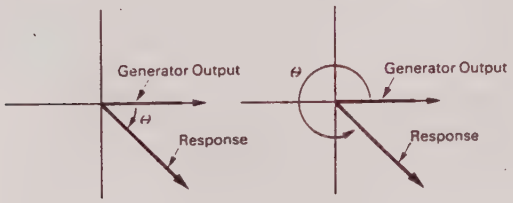
Operating Temperature Range: 0° to 45°C
Specification Temperature Range: 20°C ±10°C
Storage Temperature Range: −30°C to 70°C

Dimensions:	**Bench Use**	**Rack mounted (19")**
Height	196mm (7.7")	177mm (7")
Width	440mm (17.4")	483mm (19")
Depth	533mm (21")	490mm (19.4")
Weight	24kg (53 lb)	

Power Requirements:
110-135 or 220-270V
48-65Hz single phase ac

Details of the company environmental standards are available upon request.

STANDARD DISPLAY OF θ OPTIONAL DISPLAY OF θ



10Ω output impedance
Rear access for input and output signals
Mains input lead with DIN connector

Customer Options: Silent touch key operation
Radian display of θ

Accessories Supplied:

QTY		Part Number
2	Cable assemblies*	354004390
1	Cable assembly**	354004380
1	Lamp extractor tool	A1720061
2	Rack mounting ears	33010051
1	Mains input lead	480140220
1	Test Module	1188
1 Set	Operating Cards (abridged operating instructions).	A1720171
1	Operating manual	A1720164
1	Fuse 2A	360103100
1	Fuse 5A	360103130
3	Lamps	300710880
1	Custom built carrying case	

* Double 4mm plug to two single 4mm plugs
** Double 4mm plug to double 4mm plug

1172

WITH REAR ACCESS

With the rear access factory option fitted the specification is unchanged except in the following particulars:-

GENERATOR, COMMON TERMINAL ISOLATION,

Common to Ground: Capacitance <400pF

ANALYSER

INPUT SYSTEM

Impedance (X and Y): 1MΩ ±2% in shunt with approximately 120pF

LO Terminal to ground: Capacitance <350pF

ISOLATION

Between Input Channels: For 1kΩ across input 90dB up to 99.99Hz

REJECTION, Common Mode: For 1kΩ imbalance 140dB at dc, 55dB at 50Hz

1188 TEST MODULE: This specification printed on the module is valid from f min to 100 times f min.

SECTION 2

The Display & Controls

a,b Display 2.4
Analyser Display 2.2
2. 11
Automatic Bias Rejection 2. 17
Auto Range Keys 2. 16

Bias - Connecting to the System on Test 2. 27
- DC 2. 17
2. 27
- Keys 2. 17
2. 27
- Polarity 2. 27
- Rejection 2. 17

Carrier Keys 2. 18
Cartesian Display 2. 4
CLEAR Key 2. 22
Computer Control 2. 12
Control - Keys 2. 12
- Local 2. 12
- Remote 2. 12
Connecting Bias to the System on Test 2. 27

DC Bias 2. 17
2. 27
Delay, Measurement 2. 10
Demod Input Key 2. 18
Direction of Sweep 2. 23
2. 24
Display 2. 2
2. 11
Display - a,b 2.4
- Analyser 2.2
2. 11
- Cartesian 2.4
- In Phase 2. 2
2. 11
- Keyboard 2. 2
- Log Polar 2. 3
2. 11
- Log R, Θ 2. 3
2. 11
- Phase Angle 2. 3
- Polar 2. 3
2. 11
- Quadrature 2. 2
2. 11
- R, Θ 2. 3
2. 11

Downward Sweep 2. 23
2. 24

ENTER Key 2. 22

Frequency, Range Keys 2. 22
Sweep Keys 2. 23
Front Panel 2. 6
Fundamental Component -
of a Square Wave 2. 25
of a Triangular Wave 2. 25
Fuse - Mains 2. 29

Generator Output - Terminals 2. 26
- Waveform 2. 25

HOLD Key 2. 23
2. 24

Inphase, Range Keys 2. 15
Terminals 2. 28
Input, Range Keys 2. 15
Terminals 2. 28
Integration 2. 8
- Keys 2. 8
- Time 2. 8
2. 9
- Time Selection 2. 8
2. 9
Invalid Indication 2. 2
2. 14
2. 18

Key - Auto Range 2. 16
- Clear 2. 22
- Demod Input 2. 18
- Enter 2. 22
- Hold 2. 23
2. 24
- Linear Sweep 2. 23
- Log. Sweep 2. 23
- Mod. Output 2. 18
- Off 2. 23
2. 24
- Recall 2. 22
- Recycle 2. 14
- Single 2. 14
- Stop 2. 14

Keyboard 2. 19
- Display 2. 2
Keys - Bias 2. 17
2. 27
- Carrier 2. 18
- Control 2. 12
- Display 2. 11
- Frequency Range 2. 22
- Frequency Sweep 2. 23
- Input Range 2. 15
- Integration Time 2. 8
- Measurement 2. 14
- Measurement Delay 2. 10
- Mode 2. 13
- Monitoring 2. 19
- Programming 2. 21
2. 22
2. 23
- Waveform 2. 25

Linear Freq. Sweep 2. 23
Local Control 2. 12
Log Polar Display 2. 3
Log. R,Θ Display 2. 3
2. 11
Log. Freq. Sweep 2. 23

Mains - Fuse 2. 29
- Input Plug 2. 29
- Voltage Selector Switch 2. 29
Measurement - Delay Keys 2. 10
- Keys 2. 14
- Of X Input 2. 13
- Of Y Input 2. 13
- Ratio 2. 13
- Single 2. 14
Measurements - Point to Point 2. 5
2. 13
- Repetitive 2. 14
Mode Keys 2. 13
Mod. Output Key 2. 18
Monitoring - Keys 2. 19
2. 20
- The Output Signal 2. 19
2. 20

OFF Key 2. 23
2. 24
Output - Monitoring 2. 19
2. 20
- Terminals 2. 26

Output - Waveform - Sine 2. 25
2. 26
- Square 2. 25
2. 26
- Triangular 2. 25
2. 26
Overload Indication 2. 2
2. 15

Panel - Front 2. 6
- Rear 2. 29
Phase Angle - Presentation 2. 3
Plug - Mains Input 2. 29
Point to Point Measurements 2. 5
2. 13
Polarity - Bias 2. 27
- Indication 2. 2
Polar Display 2. 3
2. 11
POWER Switch 2. 7
Programming - Keys 2. 21
2. 22
2. 23
- An Output Signal 2. 21
2. 22
2. 23
2. 25

Quadrature Display 2. 2
2. 11

Ratio Measurements 2. 13
Rear Panel 2. 29
RECALL Key 2. 22
RECYCLE Key 2. 14
Rejection of dc Bias 2. 17
Remote Control 2. 12
Repetitive Measurements 2. 14
R, Θ Display 2. 3
2. 11

Selection of Integration Time 2. 8
2. 9
Setting-up an Output Signal 2. 21
2. 22
2. 23
2. 25
Settling Time 2. 10
Sine Wave Output 2. 25
SINGLE - Key 2. 14
- Measurement 2. 14
Square Wave - Amplitude of
Fundamental Component 2. 25
- Output 2. 25

STOP Key 2. 14
Sweep - Direction 2. 23
2. 24
- Downward 2. 23
2. 24
- Linear 2. 23
- Log. 2. 23
- Upward 2. 23
2. 24
Switch - Mains Selector 2. 29
- Power 2. 7
Switching On 2. 7
Terminals - Bias Output 2. 26
- Chassis 2. 26
- Common 2. 26
- Earth 2. 26
- Generator Output 2. 26
- Input 2. 28
Time - Settling 2. 10
Touch Keys 2. 6
Triangular Wave - Amplitude of Fundamental Component 2. 25
- Output 2. 25
Upward Sweep 2. 23
2. 24
Voltage Selector - Mains 2. 29
Waveform - Keys 2. 25
- Output 2. 25
X Input - Measurement 2. 13
- Terminals 2. 28
Y Input - Measurement 2. 13
- Terminals 2. 28
Y/X Measurements 2. 5
2. 13

SECTION 4

Using The Controls

Automatic Frequency Sweeps 4.22, 4.42, 4.43

Bias - Effect on Measurements 4.31
- Programming 4.16
- Rejection 4.2, 4.31

Change of Format when Programming 4.8, 4.9
Changing the Direction of a Sweep 4.29
Changing the Type of Sweep 4.29
Choice of Sweep Increment 4.28
Correction of Programming Errors 4.17

Decimal Point - Automatic Positioning of 4.6, 4.9
- Fixed 4.6, 4.9, 4.21
- Hz Range 4.5
- kHz Range 4.6
- mHz Range 4.5
- Log. Increment 4.21
- Programming 4.5, 4.6
- Voltage Range 4.12

DC Bias - Effect on Measurements 4.31
- Rejection 4.2, 4.31

Downward Frequency Sweeps 4.27

Effects of DC Bias 4.31

Errors - Correction of 4.17

Fixed Decimal Point: 4.6, 4.9, 4.21
Format Change 4.8, 4.9
Frequency - Programming 4.4 to 4.11
Frequency Response Measurement 4.32
Frequency Sweeps -
- General Description 4.18, 4.26 to 4.30

General Setting-up 4.2

Holding a Sweep 4.29

Input Bias - Effect on Measurements 4.31
- Rejection 4.2, 4.31
Incorrect Results 4.11, 4.17

Increment - Choice of 4.28
Keyboard - General 4.3
Leading Zeros 4.7, 4.11

Linear Sweeps - Description 4.18
- Programming 4.23, 4.24, 4.25

Logarithmic Sweeps - Description 4.19
- Programming 4.20, 4.22

Manual Sweeps 4.22
Measurement: - of Frequency Response 4.32

Output Bias - Position of Decimal Point 4.16
- Programming 4.16
Output Frequency - Programming 4.4
4.11
Output Voltage - Minimum Output 4.13
- Position of Decimal Point 4.12
- Programming 4.12
4.13
4.14
4.15
- Resolution 4.14
4.15
Overwriting Digits 4.10

Point to Point Measurements 4.33
4.34
4.35
Programming - Errors 4.17
- General Procedure 4.2
- Linear Sweeps
- Logarithmic Sweep
- More than four Digits 4.10
Programming Output Frequency 4.4
4.11
- Hz Range 4.4
- kHz Range 4.6
4.9
- mHz Range 4.7
4.8
Programming Output Voltage 4.12
4.13
4.14
4.15

Redundant Zeroes 4.7
Re-formatting 4.8
4.9
Rejection of dc Bias 4.31

Setting-up - General 4.2

Slowing Down a Sweep 4.29
Stopping a Sweep 4.30

Upward Sweeps 4.26

- The Keyboard 4.3

Voltage - Programming Bias 4.16
- Programming the Output 4.12
4.15

Writing Over Digits 4.10

Y/X Measurements 4.33
4.34
4.35

Zeroes - Leading 4.7
4.11
- Redundant 4.7

SECTION 5

Functional Checks

a,b Display 5.10

Bias Reject 5.12
Bias Negative [-ve] 5.7
Bias Positive [+ve] 5.6

Cartesian Display 5.10

DC Bias Reject 5.12

Freq. f - Key 5.4

Initial Conditions [On switch on] 5.3
Input Voltage Ranges 5.10
Input Reject 5.12
Integration Time 5.11

Log. Polar Display 5.10
Log. R,Θ Display 5.10

Measurement Delay 5.12
Measurement 5.9
Min Key 5.11
Mode 5.11

Negative Bias 5.7

Output Add 5.6
5.7
Output Frequency 5.4
Output Voltage 5.5
5.5
Output Waveform 5.9

Point to Point Measurement 5.11
Polar Display 5.10

Positive Bias 5.6
Power Switch 5.3

Ranges 5.10
Recall 5.8
Recycle 5.9
Rejection of Bias 5.12
Remote Control 5.3
R,Θ Display 5.10

Sine Wave Output 5.9
Single Key 5.9
Square Wave Output 5.9
Stop Key 5.9
Switching On 5.3

Test Module - Use Of 5.13
Triangular Wave 5.9

Waveform Keys 5.9

X Input Measurement 5.11
X10 Key 5.11
X100 Key 5.11
X1000 Key 5.11

Y Key 5.11
Y/X Key 5.11

.1 Key 5.12
1 Key 5.12
10 Key 5.12
100 Key 5.12

PERFORMANCE CHECKS

Users who wish to check the operation of an instrument on initial receipt and to record the results of this and subsequent performance checks are recommended to use the following pages. The test equipment required is shown on the first page. The following pages detail the settings and connections to be made for each check, together with the acceptable limits.

Five results columns are given to allow a record to be made of the observed results over a period of time. The frequency of carrying out the performance checks is decided by the user but if a 3 month period is chosen the record will show any change of performance over a year.

Type No.	
Date Received	

CALIBRATION RECORD FOR 1172/1177

INSTRUMENT SERIAL No. _____

1. Equipment

	Type	Serial No.
Digital Counter Timer[1]		
DC Digital Voltmeter[2]		
AC, RMS sensing Digital Voltmeter[3]		
Total Harmonic Distortion Meter		
Standard Resistance 1MΩ ± 0.1%		
Standard Resistance 200Ω ± 0.1%		
Standard Resistance 1kΩ ± 1%		

1. Better than 0.001% accurate
2. Better than 0.05% accurate
3. Better than 0.1% accurate

2. General

The touch buttons on the 1172 should be put into the state which is automatically called up when first switched on and should be returned to this state at the end of each test.

The notation FREQ = 1.000kHz denotes that a frequency of 1kHz should be entered via the keyboard. Measure X means select X and then operate the single button.

Test	Conditions	Connections	Limits	Test Results Date	Test Results Date	Test Results Date	Test Results Date	Test Results Date
1. Frequency Accuracy	Volts = 9.000	Generator output to Counter						
1.1	FREQ = 9.999kHz		10.000kHz 9.998kHz					
1.2	FREQ = 1.000kHz		1.0001kHz 999.9 Hz					
1.3	FREQ = 800.0Hz		800.08 Hz 799.92 Hz					
1.4	FREQ = 100.0Hz		100.01 Hz 99.99 Hz					
1.5	FREQ = 60.00Hz		60.006 Hz 59.994 Hz					
1.6	FREQ = 10.00Hz		10.001 Hz 9.999 Hz					
1.7	FREQ = 4.00Hz		4.0004 Hz 3.9996 Hz					
1.8	FREQ = 1.00Hz		1.0001 Hz 999.9 mHz					
1.9	FREQ = 200.0mHz		200.02 mHz 199.98 mHz					
1.10	FREQ = 100.0mHz		100.01 mHz 99.99 mHz					
1.11	FREQ = 10.00mHz		10.001 mHz 9.999 mHz					

Test	Conditions	Connections	Limits	Test Results Date	Test Results Date	Test Results Date	Test Results Date	Test Results Date
2. Generator Amplitude	FREQ = 40.00Hz	Generator to AC Voltmeter						
2.1	VOLTS = 9.990		10.50 9.50					
2.2	VOLTS = 3.330		3.500 3.170					
2.3	VOLTS = 1.000		1.050 0.950					
2.4	VOLTS = 0.100		0.105 .0950					
2.5	VOLTS = 0.010		0.0105 0.0095					
3. Generator	FREQ = 400.0Hz VOLTS = 9.990	Generator to Distortion Meter	< 1%*					
4. Output Impedance	FREQ = 400.0Hz VOLTS = 1.000	Generator to both X and Y						
4.1	Measure Y							
4.2	Measure X	Connect 200Ω across Generator output						
4.3	Read Y/X		2.04 1.98					

*This test measures harmonic distortion and other spurious products while the instrument specification refers only to harmonic distortion. The specified conditions allow for this effect.

Test	Conditions	Connections	Limits	Test Results Date	Test Results Date	Test Results Date	Test Results Date	Test Results Date
5. Bias * Output	Bias "Output Add" on.	Bias Output to DC DVM						
5.1	+ BIAS = 9.99		+ 10.5 + 9.5					
5.2	+ BIAS = 1.00		+ 1.05 + .95					
5.3	+ BIAS = .50		+ .525 + .475					
5.4	-BIAS = 1.00		− 1.05 − .95					
6. Input Impedance	FREQ = 40.00Hz VOLTS = 1.000	Generator to X input and Generator to Y via 1MΩ						
6.1	Measure Y/X		.5100 .4900					
7. DC Common Mode Rejection	FREQ = 40.00Hz VOLTS = 0.000 + BIAS = 9.99 Add Bias on Integration time X10	Common to Ground Bias to X (Lo) X (Hi) to X (Lo) via 1kΩ						
7.1	Measure X Read dB		< − 20dB					

*1172 only

Test	Conditions	Connections	Limits	Test Results Date	Test Results Date	Test Results Date	Test Results Date	Test Results Date
8. AC Common Mode Rejection	FREQ = 50.00Hz	Common to Ground Generator to Y (Hi) and X (Lo) X (Hi) to X (Lo) via 1kΩ Y (Lo) to Ground						
8.1	Measure Y/X Read dB		>60dB					
9. Isolation	FREQ = 100Hz VOLTS = 9.990	Generator to Y (Hi) Common to Y (Lo) X (Hi) to X (Lo) via 1kΩ						
9.1	Measure Y/X Read dB		>100dB					
10. Dynamic Range	Input Range 1V	Generator to X input						
10.1	FREQ = 400.0Hz VOLTS = 2.630		No Overload					
10.2	FREQ = 4.000kHz VOLTS = 1.580		No Overload					

Test	Conditions	Connections	Limits	Test Results Date	Test Results Date	Test Results Date	Test Results Date	Test Results Date
11. Bias * Reject	FREQ = 400Hz VOLTS = 1.000 BIAS = 9.99	Generator to X (Hi) Bias to X (Lo)						
11.1	No Bias Add No Bias Reject Measure X		Answer has four digits					
11.2	Bias Add on No Bias Reject Measure X		Answer has three digits					
11.3	Bias Add on Bias Reject on Measure X		Answer has four digits					

*1172 only

Test	Conditions	Connections	Limits	Test Results Date	Test Results Date	Test Results Date	Test Results Date	Test Results Date
12. X and Y Accuracy	FREQ = 40.00Hz Measure X	Generator to AC DVM and X input						
12.1	VOLTS = 9.990		$V_1 - V_2$ * =< ± 50mV	V_1 V_2				
12.2	VOLTS = 1.000		$V_1 - V_2$ =< ± 5mV	V_1 V_2				
12.3	VOLTS = 0.100		$V_1 - V_2$ =< ± 0.5mV	V_1 V_2				
12.4	VOLTS = 0.010		$V_1 - V_2$ =< ± .05mV	V_1 V_2				

*V_1 = 1170 display. V_2 = dvm reading. Record both.
The limits include ± 0.1% to allow for the AC, DVM inaccuracy.
A greater allowance may be necessary with some voltmeters.

Test	Conditions	Connections	Limits	Test Results Date	Test Results Date	Test Results Date	Test Results Date	Test Results Date
13. Y/X Accuracy	FREQ = 40Hz Measure Y/X	Generator to X and Y						
13.1	VOLTS = 9.990		1.005 .9949					
13.2	VOLTS = 1.000		1.005 .9949					
13.3	VOLTS = 0.100		1.005 .9949					
13.4	VOLTS = 0.010		1.005 .9949					
14. Sweep * Test	Follow Instructions on 1188	Plug in 1188	See 1188					

*1172 only

NEWTON ABBOT PLASTICS LTD.
Tel. 0626 63355.

Eurotech House, Burrington Way,
Plymouth, Devon. PL5 3LZ
Tel: 0752 772773
Telex: 45155 (Admin)
Telex: 45592
Telefax: 709897

MP MASTER
MA24159

Hatfield Components, a division
Wandel & Golterm